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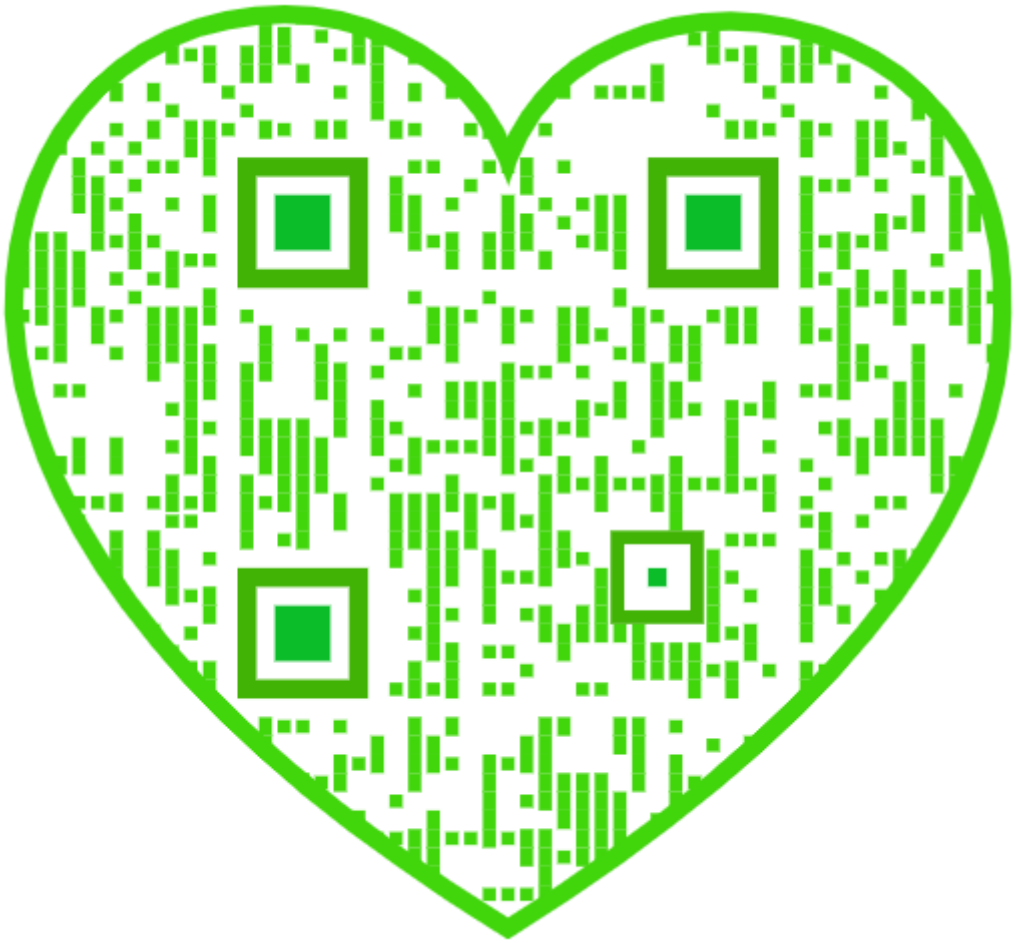

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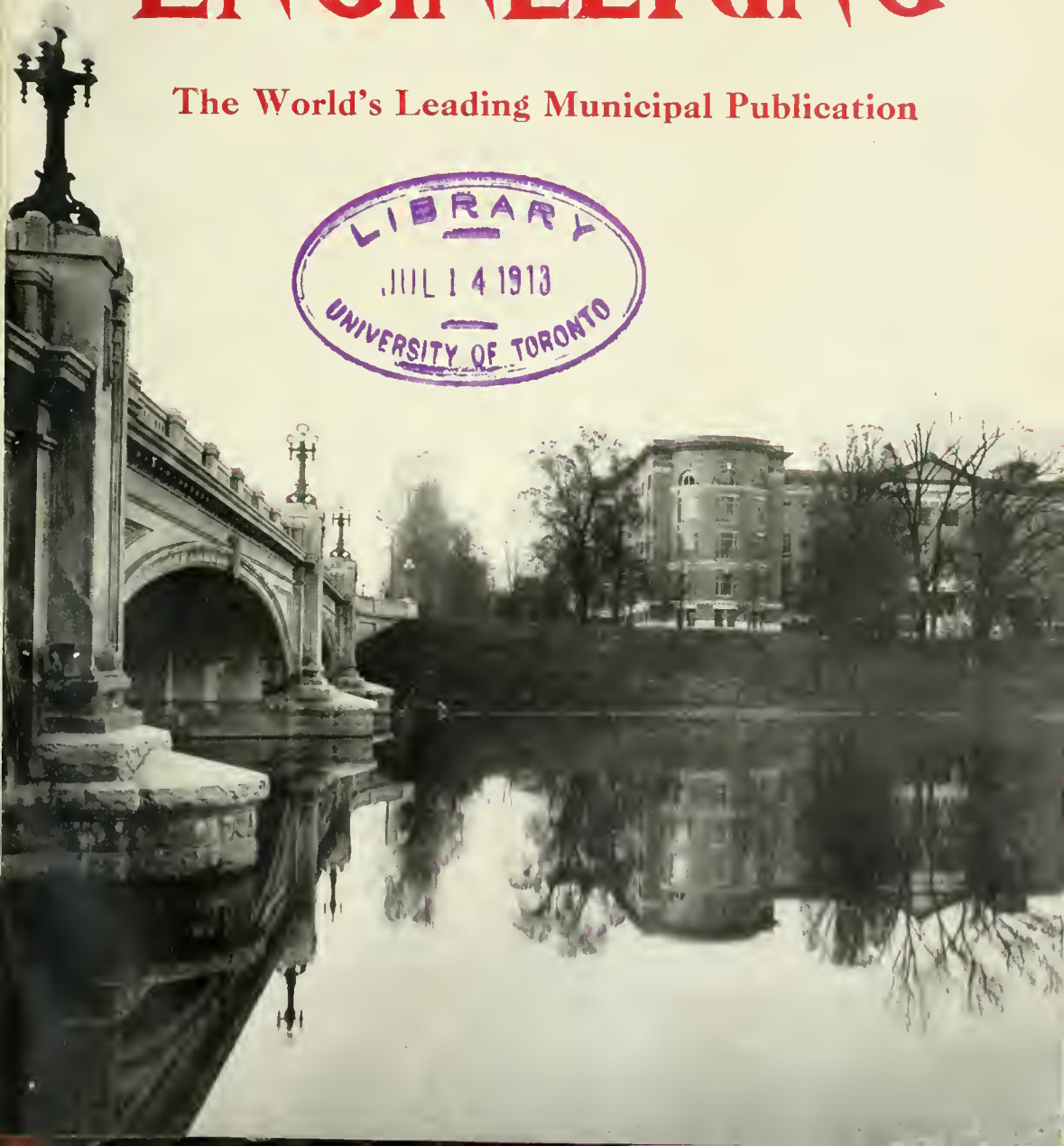

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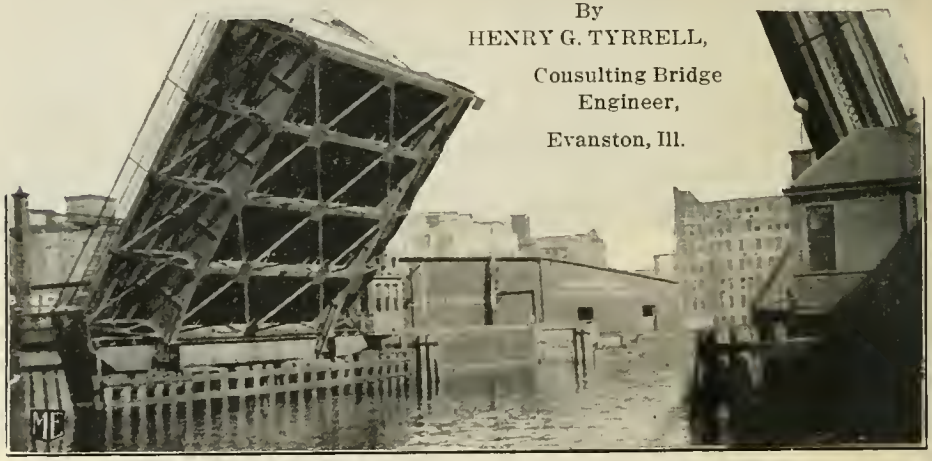
LIFT BRIDGES OF MILWAUKEE

By
HENRY G. TYRRELL,
Consulting Bridge Engineer,
Evanston, Ill.



BEST TYPE OF LIFT BRIDGE *in Milwaukee. A plate girder lift.*

MILWAUKEE is a leader in bridge building. Some of the first and best bascule bridges in America were erected there, and the types represented at Grand avenue and Broadway river crossings are in many respects still used as models for more recent ones elsewhere. The presence of the early bascule types at Holton, Huron and Sixteenth streets, while not so successful as later ones, show that the city was willing to experiment and pioneer in a branch of engineering which was then insufficiently understood in America.

In order better to appreciate the importance of bridges in Milwaukee, reference must be made to the harbor and its shipping, which are of such great importance as to be one of the chief causes, if not the principal reason for the city's location and growth.

In recent years the volume of shipping has rapidly increased. The following figures show the amount of shipping in tons at four important lake ports, and its increase during the decade from 1897 to 1907.

	1897	1907
Milwaukee.	3,750,000 tons	7,696,000 tons
Chicago ...	10,643,900 tons	11,410,500 tons
Cleveland .	6,118,900 tons	12,247,600 tons
Duluth ...	4,776,000 tons	19,635,800 tons

It appears, therefore, that in ten years, the shipping at Milwaukee more than doubled, and is rapidly approaching that at Chicago, which has both branches of the Chicago river and the Calumet river in addition, the latter receiving a large amount of coal and ore.

The first three bascule bridges in Milwaukee were those at Holton, Sixteenth and Huron streets, built nearly twenty years ago. The Holton street bridge, built by the Milwaukee Bridge Company in 1894 from plans by Shailer and Schniglau is the only remaining bridge of its kind, the three similar ones at Chicago having been removed. It has a clear opening of 70 feet, with a deck 43 feet wide and 65 feet above water. It has several times been repaired and strengthened, but is still in use.

The Sixteenth street viaduct, 4,000 feet long, over the Menominee valley, contains an opening span with double leaves, built by the Wisconsin Bridge Company in 1895, from designs by their engineer, J. Geist, but patented September 28, 1893, by Max G. Schinke, assistant city engineer. It is of the type invented in 1862 by C. T. Guthrie for military purposes in spans of 10 to 40 feet, and developed later by Lieutenant J. C. Ardagh. Its deck is 54 feet wide and 38 feet above water and when open the clear channel is 68 feet, tho the distance between pier centers is 88 feet. Each leaf weighs 65 tons, and they are latched under live loads. As the center of gravity of the whole mass moves back and forth in a horizontal line, the machinery is required to do no lifting, and it works easily, and opens in thirty seconds. The opening span cost $42,000. At the time of its construction George H. Benzenberg was city engineer.

The Huron street bridge, built in 1896 by the Milwaukee Bridge and Iron Company, was designed by Max G. Schinke, and patented by him in March, 1895. It has two leaves, each 46 feet long, and a 34-foot road with double outer walks. At each end are fixed approach spans of 87 and 42 feet. The river is 220 feet wide, but the channel is only 78 feet clear. Each leaf weighs 127 tons, including 50 tons of counterweight composed of pig iron and cement mortar. Each leaf can be opened by a 24-horse-power motor in 30 seconds. The centers of gravity of the leaves move in a horizontal line easily on roller bearings, which have several times been replaced. The floor consists of two layers of plank, and when the leaves are raised, the open space in the floor is large enough for a man or a horse to fall thru. It opens about twenty-five times per day, and cost $48,000. When inspected by the writer a year ago, the road was found to have no guard gates, and the pulling strut trunnions, which are above the floor adjoining the sidewalk, were running with oil, exposing pedestrians to injury.

HENRY GRATTAN TYRRELL, *consulting bridge engineer, Evanston, Ill.*

A repetition of bridges such as those unsymmetrical ones carrying steam railways over the rivers on the south side, should be discouraged, for while they are interesting mechanical novelties and quite commodious, their presence adds nothing to the attractiveness of the district. A two-track wrought-iron swing span on the Chicago, Milwaukee and St. Paul Railway, over the Menominee river near the Union Station, was built from designs by Charles Shaler Smith in 1881. It was 216 feet long and turned by hand power. In 1886 it was replaced by another one 203 feet long on a skew of 63

GRAND AVENUE LIFT BRIDGE, *Milwaukee, Wis.*

degrees, with equal arms, and a channel opening of 50 feet. It was afterwards found that a channel width of 75 feet was required, and tho the old bridge was quite strong enough, it was replaced in 1904 by a new one with the pier out of center. The arm lengths are 133 and 49 feet, and the new span weighs 650 tons, not including 225 tons of concrete counterweight. Only a small height was available from rail to water, and the drum is therefore very shallow. In the year 1902 it was opened 9,000 times, oftener than any other bridge on the road. Another swing on the same road, over the Kinnickinnic river, two miles further south, likewise has unequal arms. It was completed four years ago.

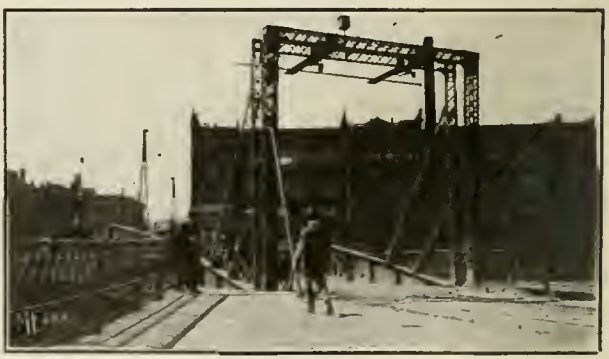
A single track swing bridge weighing 128 tons, was placed over the Kinnickinnic river in 1880 for the Chicago and Northwestern Railway. It was pin connected and 177 feet long, but in 1898 it was replaced by a double track structure 234 feet long, the old one being moved 200 feet down stream during the building of the new one. The turntable is a square box with corner girders, thus avoiding the expense of a circular drum, and making the pier diameter a minimum. Ten years later the same road moved its lattice bridge from Kinzie street in Chicago to Milwaukee, where it was re-erected over the Kinnickinnic river just east of Clinton street. Three extra panels were added to the north end, the weight of which was counterbalanced by material beneath the floor at the opposite end.

But by far the most interesting bridges in Milwaukee are the bascule spans, ten of which now cross the rivers at Grand avenue, Broadway, Muskego avenue, West Water street, First and Sixth avenues, Kinnickinnic avenue, East Water street, Michigan street and Oneida street.

The Grand avenue bridge was the first regular trunnion bridge in America. It has a clear distance of 95 feet between fenders, but as it crosses the river on an angle, the channel width is only 70 feet. It has tail pits and the arms have cantilever action when down. Its total cost was $85,000. The break in the floor was incorrectly placed, causing dirt from the roadway to slide down into the machinery pits.

The Broadway bridge, nearer the harbor mouth, is sometimes opened 150 times per day, and it is one of the busiest bridges in America. It has a 100-foot clear channel, with arms in the form of an arch when closed, and it cost complete $125,375. The Michigan street bridge bears the simple and appropriate tho unusual inscription on a metal plate, "built by the people of Milwaukee," a practice quite different to that of placing on the name plate the names of all the local aldermen who chance to be serving at the time of its construction.

The amount of power on the early bascule bridges was insufficient, and it has



OLD LIFT BRIDGE *at State and Martin Streets, Milwaukee, Wis.*

been about doubled on the later ones, that at Michigan street having a 50-horsepower motor on each leaf, and requiring 40 amperes to open it. Some further particulars of the modern bascule bridges are given in the following table.

A fine new bridge has been completed at Oneida street and one is soon to be placed at Buffalo street at a cost of $175,000. The old swing, which was built by a local company 38 years ago is very light, inadequate, and otherwise unsatisfactory.

Milwuakee Bascule Bridges

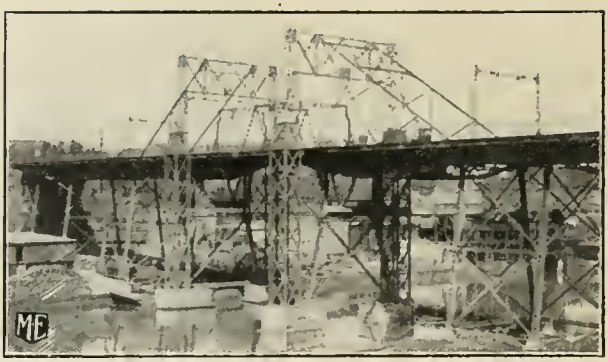
Street and Stream	Constructed	Clear Channel Ft.	Width, Ft.	Cost
Grand Avenue, Milwaukee	1902	70	64	$85,000
Broadway, Milwaukee	1903	100	60	125,375
Muskego, Menominee	1904	70	50	93,800
West Water, Menominee	1904	75	60	127,400
First Avenue, Menominee	1907	100		
Sixth Avenue, Menominee	1907	100		
Kinnickinnic, Kinnickinnic	1908		64	
East Water, Milwaukee	1909			
Michigan street, Milwaukee	1910		60	
Oneida Street, Milwaukee	1912			

Movable bridges usually show a greater lack of aesthetic treatment than almost any other form, and many of them are about as ugly as could be imagined, tho the modern ones in Milwaukee are about the finest of their kind yet produced in America. Like other bridges, their appearance depends chiefly on their outline, and their form should, as far as possible, show their purpose and action. If a wrong outline is chosen, no amount of after treatment can remedy the error.

As a general rule, each individual case will require different treatment. In cities like Chicago, London or Berlin, where the land adjoining the river is low, the bridge designs are perhaps more difficult to treat satisfactorily, and yet these cities, especially the last, have many examples of great merit. The height of the deck above the water greatly influences the design, and the required under-clearance may fix or determine the bottom outline. Deck bridges are nearly always preferable to thru ones, and should be used wherever enough height is obtainable beneath the floor for framing. In this respect the bascule bridges in Milwaukee are much superior to those in other cities, where thru trusses are used instead of plate girders, but plate girders are economical only for comparatively small channels. It should be noted, however, that the Tower bridge at London, with its clear opening of 200 feet, has plate girders beneath the moving leaves instead of trusses, tho the latter type are generally used in Chicago, where the river openings are only 140 feet. The reason for prefering deck bridges is evident, for parts above the floor obstruct the view, and may be a serious hindrance to travel, especially during crowded hours or in such emergencies as fire. When enough height is available, a curved form generally looks better than a straight one, tho the latter leaves more space for the passage of boats and river craft.

The design of bridges is also greatly influenced by the angle of the crossing, whether square or skewed, and by the approach grades. Double leaf bascules are the best form for decorative treatment, for the outline of the two leaves can be made symmetrical, and if the moving span forms a part of a long viaduct, such as those at First and Sixteenth streets, the bascule curves might be made to correspond with others in the adjoining spans. Single leaves are not artistic, for they lack symmetry. A combined bascule and cantilever, such as that patented by Mr. Newton, of Milwaukee, has a greater clear width between the piers, but the leaves, when raised, are unprotected, and none of this kind have yet been built.

A curved outline for the bottom chord,



HOLTON STREET LIFT BRIDGE, *Milwaukee, Wis.*

as on the Broadway bascule, usually looks well, and is suitable when the necessary height is obtainable, the form being used in 1839 for the Ouse river bridge at Selby, England, which has for half a century been the prototype for later ones. It is rather unfortunate that such designs as those at Stettin over the Oder, and at St. Petersburg over the Neva, have not been introduced in American cities, for they are not only commodious but are quite as attractive as any other beautiful city feature could be. Indeed they are much more prominent than beautiful park bridges, because of their location in the center of the city, where they can be seen by great multitudes daily.

Double leaf bascules are quite unsuited for railway service, as was proven prior to 1871, at Rhyl, where such a one was found to be a failure, because the center lock was insufficient to insure safe passage of locomotives from one leaf to the other. Notwithstanding this conclusion more than forty years ago, efforts have since been made to use double leaves for railway service, and two were installed in Chicago, tho the one at Campbell avenue was removed a year or two ago, for the same reason as that at Rhyl. Bascules such as the recent ones at Rotterdam and Duisburg, with two double leaf spans close together, would be applicable in Milwaukee, but all such adornment would of course add expense to the structures. The prize designs made in 1850 for a monumental bridge over the Rhine at Cologne, had a double bascule at the center, with imposing central towers connected with an overhead footbridge, similar to that on the Tower bridge at London.

A most fitting and suitable place for a beautiful or even monumental bascule bridge, would be at the State and Martin street crossing of the Milwaukee river. Such a structure would again single out Milwaukee as the pioneer in artistic bridge construction, as it already is a pioneer in its fine and commodious bascules, which, as far as mechanical operation are concerned, are nearly perfect. A combination of fine mechanical action, with architectural features, which might serve as memorial or monumental adjuncts, would be beautifully appropriate, especially in such close proximity to the city hall. And since the city is so prosperous commercially, and is rightly proud of its progress and achievements, it may well contribute a little extra appropriation for this bridge, in order to make it one of the show objects of the city. In addition to two car tracks the traffic is heavy and it is all crowded on a 16-foot roadway. Bonds for $150,000 for a new bridge have been voted.

Tourists who have returned from Europe, know very well how impressive are many of the fine bridges in the foreign capitals, or along the rivers of central Europe, such as. the Seine and Rhine. They will remember the bridges of Dusseldorf, Worms, Mainz, Cologne, Paris and Berlin, after many other objects have been forgotten. Even at London, with many persons, the bridges over the Thames are of greater interest than

the beautiful or historic buildings along its banks. And in proposing a fine monumental bascule bridge for Milwaukee, the same interest would develop here, so that the Cream City, which is already a convention favorite, would be all the more attractive.

An impression has long prevailed that bridge design consists only in the mechanical developments, the computation of stresses and the proportioning of parts thereto. This is quite a mistaken notion. It would be just as near the truth to say that the design of the beautiful city hall, post office or library, consisted in the mechanical equipment of elevators, heating and lighting arrangements. These are quite necessary adjuncts to a fine and commodious building, but no one would think of entrusting the whole design to a draftsman capable only of developing such mechanical ideas. Yet the design of bridges is often left to be developed by the factory, with the result that too many bridges have no other indication than a purely factory made product, with about as much aesthetic merit as the ordinary structural iron work which goes into buildings before it is covered in or enclosed from view. The productions of bridge builders in the first half of the last century are vastly superior, as far as aesthetic treatment is concerned, to the work of the last fifty years, when spans of great length have been completed in ungainly lines and uncouth proportions. It remains therefore for the progressive men of the twentieth century to return to the aesthetic standards of a century ago, and the time has now come when American cities should insist upon a higher character of bridge design, based upon the combined requirements of economic proportion and aesthetic appearance.

ROLLING LIFT BRIDGE *at Huron St., Milwaukee, Wis.*

LOS ANGELES ALDERMAN PROPOSES MUNICIPAL BIDDING ON PAVING CONTRACTS

Councilman Charles McKenzie has worked out a plan whereby the city of Los Angeles will become a prospective bidder on all paving contracts, and it is believed that it will save the property owners much money.

This plan which Councilman McKenzie has been working on for several months will do away with the present wide range of bids for exactly the same class of work in different parts of the city. He is determined that the only way that the property owners can obtain uniformly low bids on paving contracts is for the city to bid on as many contracts as it can spare money enough to carry on at one time.

In this way the contractors bidding on all street paving work will face the contingency of the city bidding on all jobs which they seek, and they will be prevented from getting together and agreeing among themselves that one shall have this contract and another take that, with the result that there is no real competition for any of the jobs, and the successful contractor gets the job practically at his own price.

The city will have to organize a street construction gang, entirely apart from the present force. It is suggested that they take as much of the aqueduct equipment as is needed and pay the aqueduct department. By so doing, teams, tools and equipment can be had at much below the cost of new equipment.

The least amount that will be necessary to start this fund for doing paving will be $2,500,000.

CONCRETE PAVEMENT CONSTRUCTION

By the Morse-Warren Engineering Co., Carlinville, Ill.

IN a previous article, the authors of the following paper discussed some "Concrete Pavement Failures," showing a need for radical changes in the methods of design and construction at present prevailing generally thruout the country. In the present article will be presented as clearly as may be a rational and definite system of design to be used as a guide in determining a correct thickness of the pavement slab, consistent with its width and strength. Headings are also included bearing on other features of construction which are most frequently neglected in pavement work.

CONCRETE ROAD *in Winona County, Minnesota. Gravel shoulders had not been put in when this photograph was taken.*

The subject will be considered under headings as follows:

Pavement Section

The methods of design here outlined are intended to provide a pavement able to sustain the traffic of cities having from five to fifty thousand inhabitants, and for successful use on country highways. The design includes the determination of the most economical shape of cross-section and the proper thickness required to resist the forces tending to rupture it.

The forces tending to crack a concrete pavement longitudinally are:

(1) Freezing and thawing.

The action of frost in the ground at the edges of a concrete pavement will create a force sufficient to raise and lower the sides of the pavement.

(2) Swelling and shrinking.

It is a very common sight to see large cracks in the natural ground, due to horizontal shrinkage during dry weather, and a fact equally well shown is that earth swells on taking up moisture. This swelling and shrinking of the earth has a vertical force sufficient to raise a pavement slab, and unless the slab is of proper thickness and strength a failure may be expected.

Observations have been made which confirm this conclusion and at the present time the writers and others are conducting careful tests to determine more definitely the amount of this vertical motion. It is certain that as much as ⅜ of an inch of vertical motion must be provided for.

(3) Settlement of sides of earth fill.

The settlement of the sides of an earth fill may exceed that at the center, where usually it is more compacted, by 5 per cent. and may amount to one inch, causing a cantilever action by depressing the sides. Even on the foundation of an old dirt road the sides are less compact and dense than the center.

Therefore the pavement may be cracked by bending moments caused by upward pressure near the sides or by the settlement of the ground below the sides. The flexibility of a concrete slab is not sufficient to allow of its conforming to these unequal movements in the foundation. The fact that miles of concrete

pavements today have cracked longitudinally is sufficient proof that a proper design was not used. The pavement slab must be designed to sustain itself under these forces and the assumed load of traffic. Some of these forces will unquestionably act on every pavement and unless the pavement slab is designed as a beam, it may be expected that longitudinal cracks will develop.

The forces tending to crack a concrete pavement transversely are:

First. Shrinkage of the concrete when curing without an abundant supply of water. This is probably the most frequent cause of failure transversely. The amount of shrinkage depends largely on the richness of the concrete used and the amount of water furnished during the first weeks. Judging from tests of Considere and others an amount of 0.05 per cent. for a 1-2-4 mixture and 0.1 per cent. for a 1-1-2 mixture is nearly what may be expected. For a block 50 feet in length this is nearly equivalent to a shrinkage of from ¼ to ½ inch and is about as much as the contraction caused by 100 degrees of change of temperature.

Second. The expansion and contraction due to changes of heat and moisture in the concrete. Contraction from these causes tends to slide the slab on the foundation generating tensile forces which frequently rupture the slab transversely, and diagonally as well when occurring in conjunction with cross bending moments.

The method of determining the proper thickness of slab in any case is outlined below:

It is assumed in the discussion that the centroid of application of these vertical forces will be one-third the distance from the edge to the center of slab, so that the actual beam considered will be two-thirds the width of the pavement. Letting h=thickness of pavement, l= length of beam considered, w =live load per square foot, and R=modulus of rupture of concrete, the formula for thickness of a plain beam with no factor of safety allowed resolves to the form,

$$(1)\quad h^2 - 0.065\,\frac{l^2}{R}\,h = \frac{w}{192}\cdot\frac{l^2}{R}$$

From which, in any case at hand, having the width of pavement, strength of concrete and assumed live load, the required depth may be obtained, to which should be added as much as 1 inch, as a factor of safety.

Two widths of pavement are herein considered by formula (1). For 9 feet in width, a live load of 200 pounds per square foot is assumed, and for 18 feet, 100 pounds per square foot. With usual moduli of rupture and a 1-1-2 mixture, the thickness required for 9 feet is 5.0 inches, and for 18 feet, 7.8 inches. And for a 1-2½-5 mixture, the thickness required for 9 feet is 5.9 inches, and for 18 feet, 9.6 inches. It will be observed that the requirements here presented necessitate a much stronger and more costly pavement than has heretofore generally been constructed, and which will, if engineers continue to build the present extreme widths of slab, increase the cost of concrete pavements to that of the standard pavements of today. Fortunately costs may be safely and greatly reduced by the use of properly constructed longitudinal joints, reducing the width of slab. Take for comparison two 9-foot and one 18-foot sections. At a cost of 15 cents per inch of thickness per square yard of area, there is a saving of 50 cents per square yard by the use of two sections 9 feet wide, with a properly constructed separation joint in the center of the roadway, the edges of the joint to be protected by a metal plate developed for that purpose. This saving amounts to about $5,000.00 per mile. Therefore in constructing a concrete pavement which exceeds 12 feet in width, it is not economical to build it in one section.

Proportions

The hardest and strongest wearing surface which can be made with Portland cement concrete is still much softer and less durable than the average brick pavement surface. From observation and tests the writers believe that the best concrete surface will wear away about five times as rapidly as brick. Hence the hardest surface that can be obtained is none too good.

The proportions of the several materials composing the concrete govern largely the strength of the body and the hardness of the wearing surface. The proportions in the body must be such as will give the strength required at the least cost. Having obtained enough strength in the body, the primary consideration must be, the construction of the hardest wearing surface possible; this is demanded by the abrasion and shock of modern traffic.

A comparison of many tests indicates that the 1-1-2 concrete possesses about 20 per cent. more strength and hardness than a mix of 1-1½-3. It therefore becomes evident that something extra must be spent to obtain the greatest durability. A pavement built entirely of 1-1-2 will cost, for concrete work, 8 per cent. more than one of 1-1½-3, but its life will be at least 20 per cent. and probably 40 per cent. greater. For when the strength of any material is overtaxed, it fails with increasing rapidity.

Should an engineer hesitate to choose a mixture of 1-1-2 concrete, having a section so thin as will provide the necessary strength, the other rational course is open to him of choosing two-course work making the body of 1-2½-5; and the top coat of 1-1-2, which will give all the advantages to be secured by a perfect concrete pavement at somewhat less cost than a one-course 1-1-2 mix. In two-course work, there is some chance to be taken of not securing a perfect bond unless the inspection is right. The writers have however seen some perfect pavements constructed in this way, and over the country, the pavements which appear to be giving the best satisfaction are two-course jobs. The several advantages of two-course work may be enumerated as follows: 1st. The ability to use the entire strength of the cement in the rich coat, whereas, if rich one-course work is employed a large per cent. of the cement may run to the sides or bottom of the slab, thereby giving a less rich mixture for the wearing surface. Second. The necessity of providing only a small amount of the most durable and most costly stone, which may prove to be uneconomical for the entire body in many localities. Third. By specifying two-course work more emphasis is placed on the importance of durability in the wearing surface, and whereas a contractor might neglect or consider too expensive the screening of all his materials in a one-course job, the screening for the top course in two-course work, where necessary, can hardly be objected to.

A possible objection to two-course work lies in the fact that shrinkage from drying amounts to much more in a rich mixture than in a lean one, which will tend to cause hair cracks to develop in the surface. These are frequently observed in cement walks. It is observed, however, that they do not appear in walks having a top as thick as 1 inch, and with a 2-inch coat these forces will adjust themselves without causing rupture.

The advantage of one-course work lies in the simplicity of its construction. Its cost is somewhat greater than two-course work for an equal hardness of wearing surface. It has been popular for the reason that a fairly good second class job can be secured at rather smaller cost.

It is believed, however, that first class concrete pavements can be built by both methods, and these specifications will cover both.

Preparing Foundations

The first consideration is drainage. This has been in the past frequently secured by French drains of crushed stone placed below the edge of pavement. The modern method of securing drainage is by laying of a vitrified field tile along the outside and distant from the edge of pavement about 1 foot and to a depth of from 15 to 30 inches, carried to a proper outlet at the first culvert. A 4-inch tile is of ample size and the cost is as follows:

Tile delivered on the work, lin. ft.	$0.025
Laying and backfilling	0.025
2 per cent. added for outlet	0.001
Total per lin. foot	$0.051

This provides a permanent, and perfect drain at a cost of not more than 5 per cent. above old time modes.

Some effective means of drainage must be employed in building a concrete pave-

ment, as it is very desirable to keep the foundation stable and avoid as much vertical movement as possible.

After the rough grading is accomplished by the use of teams or tractor, the engineer should provide finishing stakes as close as 25 feet, which allow the use of striug and template in completing the subgrade. The surface of subgrade should be finished so as not to vary at any point ½ inch from its intended position after the rolling is completed. A steam roller should be used weighing from eight to ten tons. If such can not be obtained good results may be secured by the use of traction engine. All spongy spots developed in rolling must be excavated and refilled with firm material.

It is imperative that the foundation of the pavement shall be evenly and uniformly compacted.

Quality of Materials

The quality of the materials used, together with their proportions, determine the strength and durability of the concrete to a large extent.

The sand used must be free from soft particles of stone, earth, or vegetable matter. For the body course it may run uniformly in size from ⅜-inch down to fine finishing sand, while for the top coat it should grade from ⅛-inch down.

The stone used in the body should be crushed stone of the greatest hardness and strength which can be economically obtained. For the top coat the stone must be the hardest obtainable. Crushed quartz, trap rock, or granite must be secured to give the most durable wearing surface, and, where the amount required is small per square yard, the cost per cubic yard should not be spared. Economy should play a very small part in the construction of the wearing surface of a concrete pavement. When the stone and sand are properly chosen and graded, a dense, durable concrete is obtained. The use of bank run gravel is bad practice. In fact, there is very little gravel found which has a quality good enough for use in any part of a concrete pavement.

CONCRETE Y *on State rural highway in Winona County, Minnesota.*

A great difference exists in the strength and soundness of various brands of cement. The fine grinding which some mills have adopted in recent years, allows the strength of lean mortars to run to much larger figures than were common two or three years ago. The writers have tested brands the past year some of which show on a 28-day test a tensile strength of about 600 pounds and some give a test up to 800 pounds. Many tests of neat cement strength run up to 900 pounds per square inch. In a concrete pavement where the hardest surface and greatest strength

of body is essential, a high standard of cement should be required. The expense incurred in obtaining an abundance of the best of other materials should not be discounted by the use of weak cement.

The specifications for cement adopted by the American Society for Testing Materials should be used except that thirty days shall be allowed for inspection and tests from the time of delivery to the engineer of samples, which shall be delivered within ten days from the day of award. And further, that the neat cement 28-day test shall equal 700 pounds per square inch and the one part cement, three parts standard Ottawa sand, 28-day test, shall equal 300 pounds per square inch. These specifications will include fully two-thirds the standard brands of cement and will insure the taxpayers a chance for a job of first quality.

Screening

All sand used shall be screened to secure the correct grade of size and to remove all dirt, soft stone and debris. All stone or gravel delivered which shows clods of earth, coal or foreign matter must be screened. No matter how strong and sound the cement or how rich the mixture, unless they are delivered into the mixer absolutely clean and free from foreign matter, the pavement will be sure to show pit holes and weak spots, which will start ravel and wear. To assist in keeping stone clean and facilitate shoveling, it must be piled on 2 inches of sand. This item has been found very important in keeping clods from the base out of the mixer.

Expansion and Separation Joints

Experience gained during the past years has demonstrated that transverse expansion joints should be placed from 25 to 50 feet apart, depending somewhat on the thickness of the pavement slab and on the condition of the foundation.

While engineers are fairly well agreed as to the proper spacing of expansion joints, they are greatly in doubt as to their proper protection.

The following specifications for the protection of expansion joints are believed to be the most complete and adequate yet devised and are herewith submitted. "Expansion joints shall be protected by a T-shaped soft metal bar, having the head thereof spanning the space between the sections, and the stem interposed between the confronting edges of such sections, and compressible strips disposed at the opposite sides of said stem, said stem adjacent to its lower longitudinal edge being stamped out to form lugs spaced apart and designed to be embedded in the material of the sections."

Such a bar will absolutely protect the edges of the concrete sections and, instead of making the expansion joint in a concrete pavement the source of weakness, it will give it a strength equal to that of the other parts of the pavement.

All engineers have observed the unsightly and damaging cracks near the center of the street on concrete pavements. Such cracks are not only unnecessary but very destructive to the life of the pavement, and yet they are seen on probably 95 per cent. of the pavements built today. By constructing a longitudinal separation joint in the center of the street and protecting it by a T-shaped soft metal bar, as above described for transverse joints, the damaging cracks will be absolutely eliminated.

Proper Mixing

The materials will be mixed in an approved batch mixer. Each batch will be turned over at least six times before being dumped from the machine. Every effort must be made to secure uniformity in each batch, the same amounts of water, stone and cement, lest an unevenness result in the quality of the wearing surface and strength of body. The attempt must be to secure a surface of equal durability. The mix will be made of jelly-like consistency, allowing a man to sink above his ankles, but yet not so wet that the water runs from the mass and leaves the stone deposited in one pile and the sand and cement elsewhere. Recent tests show that maximum strength is secured by using about three gallons of water to one sack of cement, in addition to a wet aggregate.

Placing the Material

Before placing the concrete, the foun-

dation will be thoroly sprinkled, which will prevent the earth absorbing the water needed to harden the concrete. The batch must be placed at once after mixing, and if two-course work, the bottom course will be wet enough, at the time of application of the wearing course, that a man will sink above his ankles, and the top course being of a like wetness, a perfect bond is secured. Both coursess are struck to the proper grade by an adjustable template. A bucket conveyor greatly simplifies this operation, both courses being mixed in the same mixer.

Finishing the Wearing Surface

A simple wooden float will be evenly applied at once to finish the surface. A float of flexible wood formed to truly fit the curve of the crown and extending entirely across the pavement will be allowed where carefully used. By this means much unevenness in the surface is avoided. No disturbance of the surface, after setting has begun, will be allowed, such as brooming or grooving, as it injures the texture and allows raveling to begin.

Surface Protection

As soon as built a wetted canvas will be spread over the surface to protect it from the sun, rain, winds, or frost. The canvas will remain until the surface has hardened enough to receive a covering of earth, which will be applied as soon as the canvas is removed. Concrete pavements are subjected more to the action of the elements than other classes of concrete work due to the large per cent. of body exposed.

Curing the Concrete

The pavement should be sprinkled twice daily, until water runs from all the surface. This should be continued for a period of ten days. Thirty days shall elapse from the day of construction of any section before it shall be opened to traffic. As a rule if the pavement can be brought thru its first 30 days in perfect uncracked condition, it is likely to continue good when of correct design. It is while in its weak condition that shrinkage from drying, contraction from cold, and action of the elements affect it most dangerously. By faithful sprinkling fully half the shrinkage from drying may be obviated. The rich top course is much more subject to shrinkage than the base.

It should be borne in mind that concrete requires a much longer time to cure in winter than in summer.

Inspection

The inspector of any pavement should be one selected, for his fitness, by the engineer. It is his duty to know that the foundation is true to grade, that the specified materials are mixed in the true proportions, in the right way, with proper wetness and laid with accurate thickness to grade. He must see that the surface is protected at once and sprinkled as specified. A daily progress report and force account must be kept. Without constant efficient inspection a successful concrete pavement can scarcely be built.

Workmanship

Nothing indicates more quickly than workmanship, the character of the job as a whole and nothing can give so certainly the stamp of high class to the job.

Conclusions

Conclusions from this article may be drawn as follows:

Economy requires that the width of slab shall not be greater than about 12 feet. When the pavement is wider than this, longitudinal separation joints shall be properly constructed.

The thickness of the section will be consistently kept in accord with its width and the strength of mixture adopted.

For this class work the hardest wearing surface possible to build will be required. A wearing surface having a weaker mixture than 1-1-2, cannot grade as first class.

It is desired to further emphasize the fact that it is impossible to build a successful concrete pavement except by the use of the best materials, the most careful workmanship and constant inspection. In fact it is a feat requiring engineering skill.

FILTRATION PLANT AT McKEESPORT, PA.

By E. C. Trax. Chemical Engineer in Charge..

SINCE 1881 the city of McKeesport has drawn its water supply from the Youghiogheny river at a point about a mile above the junction of the Youghiogheny and Monongahela. At the time of the construction of the original water works the river furnished a very acceptable source of supply. While no bacteriological records are in existence, it can be assumed that the water was not seriously contaminated with sewage, as the water shed was not thickly settled and sewer systems were less common in the smaller towns than they are today.

Industrial developments on the water shed have been very extensive, especially in the coal and coke industry, and there has been an attendant increase in the pollution of the water by sewage and trade wastes. In an attempt to secure better water a series of wells was driven along the river and a part of the supply drawn therefrom. The well water was much harder tban the river water most of the time, and the bacterial content was also very high. It became evident that a new source of supply must be obtained or the existing supply purified. Mr. Alexander Potter was retained as consulting engineer and, after a thoro investigation by the engineer and the Board of Water Commissioners, it was finally decided to purify the Youghiogheny river water. On account of the high mineral content and acid condition of this water it was evident that filtration alone would not be sufficient to produce a satisfactory supply. Plans and specifications, including provisions for softening followed by filtration thru rapid sand filters, were prepared. After approval by the Board of Water Commissioners, these plans were submitted to councils January 14, 1907. As required by law, plans were also submitted to the State Department of Health for approval.

The River Water

The water in the river is unfit for use for several reasons. Altho generally clear it is at times highly turbid and constantly contains sewage pollution. Another condition is the high hardness of the water a large part of the time and the presence of free sulpburic acid and iron salts. The acid water is very corrosive in its action and the iron makes the water entirely unfit for laundry purposes even when perfectly clear.

The cause of the acid water is the pollution with mine drainage. The trade wastes from the various mills connected with the iron and steel industry are almost a negligihle quantity. Sulphuric acid is ordinarily present in the waste water from coal mines and coal washers, being formed from the decomposition of iron pyrites by air and moisture into ferrous sulphate and sulphuric acid. Further oxidation of the ferrous sulphate may take place, resulting in the formation of oxide of iron, the brownish yellow coating on the beds of streams containing this so-called "sulphur water."

The country drained by the river is hilly and its fall is very rapid, so that it is subject to wide and sudden fluctuations in discharge. The heavy rains run off quickly, resulting in floods and low flow in dry weather. Immense amounts of acid mine water are discharged into the river and its tributaries; altho subject to some extent to seasonal variations the amount of this acid water is a fairly constant quantity. When considerable rain is falling over the water shed the mine drainage is more diluted, the acidity is reduced, and the water may even become alkaline for a few days, while during dry weather with a low stage of water in the river the acidity becomes very high. The first effect of a rise in the river is to increase the acid-

lty at McKeesport, caused by the storm water flushing out the pools in the ahead of the crest of the rise.

The longest period of alkaline water of which we have record is 11 days, from July 17 to 27, 1912, inclusive, while the longest period of acid water lasted 186 days, from June 23 to December 26, 1910. The yearly maximum and average acidity of the water since 1901 is tabulated below.

Year	Maximum	Average
1901	128	37
1902	204	36
1903	145	30
1904	162	48
1905	72	27
1906	106	23
1907	65	19
1908	240	63
1909	210	31
1910	390	81
1911	180	30
1912	140	30

The mean acidity from September 6, 1906, to September 6, 1907, was 22 parts per million, according to analyses made by the U. S. Geological Survey. It will be observed from the above table that the acidity during 1906 and 1907 is the lowest for any two years of which we have record.

The water in the river is extremely variable in its chemical and bacterial content. Chemical changes are going on constantly; the oxidation of the iron continues with the formation of greater amounts of free sulphuric acid which is more or less neutralized by the discharge into the river of small alkaline streams, increasing the sulphates of lime and magnesia. The processes of coagulation and sedimentation which are also taking place in the river all the time, altho on account of the rapid flow there is small opportunity for settling until the slack water at McKeesport is reached, and the germicidal action of the acid and iron salts, are responsible for the varying bacterial numbers in the river. The small number of bacteria and absence of B. coli during high acidity are the more remarkable because of the fact that sewage from a populous district is discharged into the river less than a mile above the water works intake. While the current is very sluggish here during low stage, due to slack water from the Monongahela river, this sewage must certainly be brought to the intake in the course of an hour.

During the past four years the total hardness has ranged from a minimum of 38 to a maximum of 804 parts per million, the acidity to phenolphthalein from 4 to 600 parts, and the reaction to methylorange from 60 parts alkaline to 390 parts acid. Some results illustrating the variability of the composition of the water are shown below in parts per million.

Date	Tot. Hard	Phenol. Read.	Methyl. Read.	Susp. Matt.
Oct. 30, 1910	804	—590	—390	None
Feb. 27, 1912	42	—5	+5	15
July 20, 1912	121	—4	+45	14,586

In the last mentioned instance the turbidity of the water was 16,000, yielding a coefficient of fineness of 0.91.

The variations are wide and sudden, frequent changes in hardness of 100 parts per million or more taking place within a few hours. In this connection the record of the daily tests for June 2, 1909, is submitted. Results are in parts per million.

Time.	Total Hardness.	Acidity to Phenolphthalein.	Acidity to Methylorange.
8 a. m.	118	90	45
11 a. m.	224	150	70
12 noon	430	300	160
1 p. m.	508	340	210
2 p. m.	440	230	140
3 p. m.	348	160	90
4 p. m.	300	110	40
6 p m.	173	80	35
7 p. m.	152	70	30
11 p. m.	116	65	40

It is thought that this acid wave was due to the dumping into the river of a quantity of partly spent acid by one of the mills above the water works intake.

The number of days the water has been acid, alkaline and neutral is shown in the following table:

FILTER ROOM, *Mckeesport water purification plant.*

Year	Alkaline (b)	Neutral	Acid (b)
1908 (Oct. 1 to Dec. 31)	0	0	92
1909	35	45	285
1910	15	5	345
1911	22	7	336
1912	46	2	318
Total	118	59	1376

(b) Acidity or alkalinity to methyl-orange.

At the end of 1907 it appeared that the acidity was gradually decreasing and that this condition of lessening acidity might be expected to continue as considerable areas of the coal on the water shed had been worked out and it was thought that the acid pollution was growing permanently less. The drainage from an old and abandoned mine, however, is usually more acid than that from an active working one, and subsequent records show that there is very little hope for better water in the river so long as mine water is permitted to enter the streams untreated.

The Purification Plant

In the latter part of the summer of 1908, long-continued dry weather with a low flow in the river, brought about a most severe acid condition of the water. The corrosive action of this fluid on the pumps, pipe system and plumbing fixtures caused a very serious state of affairs in the city; it became almost impossible to supply water and the leakage was enormous. A comparison of the pumping records for 1908 with corresponding months of other years indicates the extent of this leakage. The water softening and filtration plant was being rushed to completion at this time and an agreement was made with the contractor to begin treating the water at the earliest possible moment. The plant was

accordingly put into operation in an unfinished condition on October 11, 1908. The result was very gratifying to all concerned. The daily consumption of water was reduced during the first three months of operation from about 7,000,000 gallons to less than 4,000,000, and in place of a supply unfit for any domestic use, a clear, soft water suitable for every purpose was supplied. The cost of chemicals was, of course, very great, but this item was insignificant compared to the saving in plumbing, soap, etc. Even under such unfavorable and abnormal conditions the plant fully demonstrated that it was capable of performing the functions for which it was built.

Some data concerning the water softening and filtration plant:

Daily capacity of softening plant, 10,000,000 gallons.

Daily capacity of filter plant, 6,000,000 gallons.

Number of settling units, 4.

Capacity of each unit, 800,000 gallons.

Time of mixing at full capacity, one hour.

Number of filters, 6.

Area of each sand bed, 384 square feet.

Rate of filtration, 113,000,000 gallons per acre per day.

The Filtered Water.

The records show that since the softening and filtration operations were started, the city has been supplied with water of a uniformly high degree of purity. The water has always been remarkably clear and sparkling, free from color, turbidity, injurious substances or harmful bacteria, and has met in almost every respect the requirements of a first-class water supply.

Death rate from typhoid fever in the city of McKeesport:

Year	Death Rate Per 100,000 Pop.
1900	69
1901	81
1902	87
1903	120
1904	129
1905	63
1906 (c)	115
1907	73
1908 (d)	68
1909	18
1910	21
1911	14
1912	7

(c) Rate from 1906 to date includes residents of the city only.

(d) Filtered water first used in October, 1908.

While other sources of typhoid, such as milk supply, oysters, etc., must always be taken into consideration, it appears that much of the typhoid fever in McKeesport was due to the water supply, either the raw river water or contaminated well waters being responsible. Since purified water has been furnished many of the wells have gone out of use, and this has undoubtedly helped to reduce the prevalence of the disease.

The Lime Saturators

The lime saturator effluent is generally a clear solution of sufficiently uniform composition. This solution is tested several times each day and the lime charged into the saturators regulated accordingly.

The Settling Basins

The decreasing velocity of the flow of the water as it moves outward thru the basins along radial lines, together with the excessive precipitation, yields a most excellent settling effect. Mention has been made of the large amounts of iron and aluminum sulphate ordinarily present in the river water. The iron in solution amounts usually to from 5 to 75 parts per million, equivalent to from 1 to 22 grains per gallon of crystalized ferrous sulphate, and there is also present about one-half this quantity of aluminum sulphate. The usual method of treatment for clarification is therefore reversed, it being necessary to supply the alkalinity to neutralize the acid and precipitate the iron and aluminum. The coagulants are usually present in large excess of the amount necessary for complete coagulation, and the natural result is a high percentage of removal of turbidity and bacteria in the settling basins. The effluent is occasionally perfectly clear and is quite clear most of the time, but would not be at all satisfactory as a city supply without filtration.

The sludge disposal system has been very effective in preventing the accumulation of sediment in the baffled mixing tank and settling basins. The basins have been drained for examination and

cleaning from time to time and have been found to contain very little sludge, except in several instances when some of the drains had become clogged.

The Filters

The usual burden on the filters is largely removed by the effective settling, and washing the beds is reduced to a minimum. The average service of a filter between washings is over 120 hours, and runs as long as 200 hours frequently occur. The per cent. of wash water to the water filtered amounted to 0.3 per cent. last year, which is remarkably low. While this condition prevails a large part of the time, there are periods of very turbid and alkaline water during floods, or even following a heavy shower, when it is necessary to add coagulants, and at such times the work of the filters is increased and the length of time between washings correspondingly diminished. The turbidity is usually coarse and easily removed, often without the addition of coagulants, but occasionally a very fine turbidity has been encountered, which is extremely difficult of removal. Analyses prove this material to be almost pure silica, and as the condition has always occurred after a rain following a period of highly acid water, it is thought possible that the acid leaches the soluble salts from the material in the beds of the streams leaving a skeleton of silica, which is loosened and washed down by the flood water. It has been suggested that sedimentation in the river may be responsible for this, the coarser particles settling out while the lighter silica remains in suspension. When the water is neutral or faintly alkaline, it is occasionally completely coagulated in the river and clarifies perfectly without any treatment whatever. As a safeguard, slight treatment is always given a water of this character.

MAIN WEIR BOX, *Mckeesport water purification plant.*

The "growing" or increase in the volume of the sand in the filters due to the sand grains becoming coated with car-

bonate of lime now amounts to about 300 percent. This incrustation has taken place at some other plants using lime and sulphate of iron, and the natural result of the increased size of the sand grains has been the lowering of the efficiency of the filters. On account of the exceptional conditions of coagulation and sedimentation here at McKeesport, the efficiency of the plant as a whole has not been affected to any extent. There has been no tendency toward cementing together of the grains and it is believed that the present sand can be used several years before it will be necessary to replace it.

General Conditions in 1912

The average hardness of the raw water was slightly greater than in 1909 and 1911 and much less than in 1908 and 1910. The conditions of hardness and acidity were much more uniform than during any other recent year. As in 1911 there was a fortunate distribution of the rainfall and no long period of high hardness and acidity occurred.

The operation of the plant was satisfactory and the high standard of purity of the filtered water was maintained.

ARCADE *connecting water softening and filtration plants. Mckeesport. Pa.*

CONSTRUCTION OF TILE PIPE SEWERS IN CHICAGO

By Herbert Edson Hudson, Division Engineer, Board of Local Improvements.

A STUDY of the growth of the population of Chicago shows several striking features. Many portions of the city have shown greater rates of growth than others. The city as a whole for the period 1900 to 1910 shows the remarkable increase in its population of 28.6 per cent. A large portion of this increase in population has been in the outlying districts. There has been a great tendency for the population to spread out over the level prairies and it is this great spread of population that causes the tremendous extension of main sewers and their laterals.

During the year 1912, the reports of the Board of Local Improvements show that there were constructed 69.82 miles of tile pipe sewer and 10.28 miles of brick sewer, making a total of 80.1 miles constructed during that year. The great main sewers in Western and Kedzie avenues had been completed at this time and enabled the construction of large tile pipe systems and perhaps accounts in a degree for the large amount of sewer built during that year. There are great portions of the territory included in the city limits which are not sewered at present or are very poorly sewered and there is a possibility that the figures for 1912 will not appear so large when compared with the future figures in the reports of the Board of Local Improvements. At this time they represent the largest amount of work done by the Board of Local Improvements during any one year. The figures for brick sewers constructed in

VITRIFIED PIPE, THIRTY-SIX INCHES DIAMETER, *going into sewer trench near Chicago.*

Cuts in this article furnished by Blackmer & Post.

1909 show a larger amount than for the year 1912, but the pipe sewer figures for that year are much smaller.

Tabulated for the years 1901-1912, inclusive, the figures are as follows:

Year.	Brick Sewers.	Tile Pipe Sewers.
1901.....	4.85 miles	12.67 miles
1902.....	4.25 miles	15.17 miles
1903.....	4.25 miles	29.39 miles
1904.....	6.68 miles	31.39 miles
1905.....	8.25 miles	23.93 miles
1906.....	14.71 miles	25.44 miles
1907.....	9.42 miles	42.95 miles
1908.....	16.01 miles	36.11 miles
1909.....	16.34 miles	50.79 miles
1910.....	15.08 miles	41.32 miles
1911.....	10.87 miles	54.50 miles
1912.....	10.28 miles	69.82 miles

A glance over the table shows a great predominance of tile pipe sewer construction. With little exception there appears to have been a steady increase in the rate of construction of tile pipe sewers during this period. The figures for brick sewer construction are subject to greater fluctuations, due perhaps to the extension of large main sewers, but the figures for tile pipe show a fairly uniform increase. During the period of growth covered by the percentage of 28.6 per cent. increase in population there is an increase in sewer construction of 26.5 per cent.

The construction of sewers by the Board of Local Improvements divides itself naturally into two classes—those contracts which are large enough to warrant the installation of machinery of one kind or another, and those which require the use of hand labor exclusively. In the last few years there have been great improvements in the utility of machines for sewer excavation and the construction of tile pipe sewers has been greatly facilitated thereby. The construction of brick sewers is nearly all of such a nature as to warrant the use of machinery. Only the occasional construction of short stretches of brick sewer is carried on with hand labor.

There are also many shorter blocks of tile pipe sewer varying from 200 feet to 700 feet in length which are built at this time in excavation made by hand labor. The construction of tile pipe sewer in machine excavation is found to be economical at this time on contracts covering as little as 1,200 to 1,300 feet.

There are several types of machines now on the market, all of which give different degrees of satisfaction when operated under the varying conditions met in Chicago. For the smaller sizes of tile pipe sewer, 12 to 15 inches, these machines excavate a trench wide enough for a man to work comfortably trimming out the bottom or laying and sealing pipe. For the larger sizes, 18 inches and over, the cutting edges of the machine may be changed or upon some types of machines the boom may be oscillated to accomplish the widening of the trench. Nearly all machines upon the market are so constructed that the spoil may be thrown at varying distances from the excavation. This feature enables the contractor to spoil his earth as near the trench as the quantity of excavation will allow.

It is customary in Chicago to set grade stakes upon work to be excavated by a machine in advance of the machine, at such an offset from the center line as will properly clear all parts of the machine. These stakes should should not be too far from the actual line of the work. The various types of machine used upon work of which the writer has had charge require offsets of 6, 7 or 8 feet. The stakes are usually set by instrument on a line parallel with the center line of the work so that the operators of the machine are enabled to keep a proper alinement upon the excavation. Grade stakes are given at intervals of 20 feet so that as soon as the machine passes one stake the workmen may level a cross piece over the trench and pull a line to the cross piece leveled from the last stake. This enables the contractor to lay pipe at all times within 20 or 25 feet of the machine, and when speed is essential it greatly facilitates the handling of sheeting and bracing. The pipe are gaged to the line between cross pieces by means of a gage pole. The writer has found that the best form of gage pole is a 1-inch-square strip 12 to 14 feet long marked off in feet and mounted at the bottom with an ordinary iron shelf-bracket. This bracket is rigid and not easily broken in the ordinary course of work. When a pipe is to be laid, a trowel of ce-

LOWERING THIRTY-INCH VITRIFIED PIPE *into trench. Chicago sewer construction, 1912.*

ment is thrown into the lower part of exposed bell of the last pipe laid and spread with the trowel up the sides of the bell so as to form a bed for the spigot end of the next pipe. When the next pipe is laid and found to be at grade, the pipe layer reaches as far as possible under the sides of the bell and seals it as perfectly as he can with cement. A single stroke of the shovel of the "bottom man" will serve to remove any excess of cement that may be crowded into the interior of the pipe. A good laborer can so trim the bottom that very little adjustment will be needed to grade the pipe properly. An ordinary pail of cement will seal three or four 12 to 15-inch pipe. On the larger sizes of pipe, the proportion of cement increases until on the 30-inch pipe a pail of cement is used in sealing one joint.

There is no trouble in raising or lowering a pipe to grade when the sizes are the smaller, 12 to 15 inches. When 18-inch pipe or larger sizes are used, it is the experience of the writer that a mark should be made on the gage pole that will allow for the thickness of the pipe and the necessary excavation for the bell. If the excavation is properly gaged by this means, every pipe will go into place and meet the approval of the most exacting inspectors. This method of testing the excavation was followed on work under the writer's charge on which 30-inch pipe was used. Upon investigation of the interior, it was found that there was practically no "lipping" anywhere—side, bottom, or top. It would be hard to imagine the interior of a sewer that would be more nearly perfect from sanitary, hydraulic, or construction points of view than this 30-inch sewer. With the proper bedding of the lower half of the pipe in its bell, the interior becomes almost a perfect cylinder.

The placing of the necessary connections or junctions for house drains and catch basin connections occasions some delay, as it is necessary to dig out the bank so they may be placed at the proper angle. The writer believes that these connections should enter the sewer slightly above the springing line, being tipped up to an angle of 15 or 20 degrees. This work is accomplished on the larger sizes of pipes with little delay, but causes more delay proportionately on the smaller sizes. The slants set for house drains are sealed off immediately with a tile stopper and cement. The catch basin slants set for basins to be constructed on the same contract are usually stopped off temporarily with two bricks and a cement bag until such time as the connection is properly made.

The large amount of work done by one of the machines in a day is one of the features of this type of construction. In 1912, the writer had occasion to see a machine excavate 1,040 feet of trench for 12-inch tile pipe sewer in a cut of 8½ feet. This work was done and a move of 900 feet was made during the day from the end of one stretch of 660 feet to the beginning of another similar stretch of work. Depending upon the size and power of these machines they will excavate the trench for 12 or 15-inch tile pipe sewer in amounts varying from 400 feet per day to the figure given above. The amount of work done in a day decreases as the size of the pipe increases, due both to the increase in excavation and the difficulties encountered in handling the larger sizes. On the 30-inch sewer mentioned, the day's work was about 200 feet. These larger pipe were lowered into

place by three or four men with little trouble. A small builders' derrick was provided upon one contract for 24-inch pipe but was found more expedient to lower the pipe by hand than to use the derrick and it was therefore abandoned.

The reports of the Board of Local Improvements 1901-1912 show an increase in the size of tile pipe used as well as in the quantity. Many of the contractors expressed the opinion that there would be trouble in handling the larger sizes. These fears, however, seem to have been groundless as those who have laid the 24, 27 and 30-inch sizes have expressed their satisfaction with the handling of these larger sizes.

On sewers built in trenches excavated by hand labor the procedure is much the same except that the engineer's grade stakes upon work under the writer's supervision are set in pairs at intervals of 25 feet—one on each side of the trench. By this procedure, the cross pieces carrying the line may be placed across the trench without the use of a level or without depending upon an employe of the contractor to see that the cross piece is level. In this method, there is also an opportunity to correct the error that would occur if a stake were driven low, by leaving its corresponding stake equally high. In a cut of 8½ feet in firm clay excavation, a force of 20 men and a brick layer will ordinarily lay 200 to 300 feet of 12 or 15-inch tile pipe sewer with necessary manholes and basins as a day's work.

In some parts of Chicago it is necessary to construct sewers in water-bearing sand or gravel. In many cases of this character, it is possible to drain the surrounding ground by opening a shallow trench and allowing the water to run off for two or three days. If the cut is deep, it is often advisable to sink sheeting in a second deeper cut and allow this to drain for a short time. If it becomes apparent that there is an abundance of water in the ground, it is often advisable to install a system of well points. These points can be sunk along the sides of the trench by the use of a water jet and serve to remove the water to such an extent that the excavation is apparently carried on in dry sand. On the smaller blocks of tile pipe sewer, these points are often connected with a diaphragm pump and this combination works fairly well. On the larger contracts, it is more customary to install steam or gasoline pumps to operate these well points. If the soil is porous and the water reaches the well point readily a vacuum of 6 or 8 pounds is sufficient to keep a steady stream of water flowing from the pump. If, however, the soil is composed of fine sand and silt or impregnated with clay,

FORTY-TWO INCH VITRIFIED SEWER PIPE, *ready for sewer near Chicago.*

even the higher vacuums are not capable of drying the excavation. In many trenches that show a considerable amount of water after standing for a little time, work can be carried on with a considerable degree of success by sprinkling quantities of dry sand upon the portions being excavated and carrying on the excavation at the same time as speedily as possible.

When a sewer is built in sand excavation, the Chicago specifications require that all joints in the pipe work shall be calked with oakum. This is accomplished by placing a small rope of oakum in the lower half circle of the bell of the last

pipe when the usual trowel of cement is put in place. After the spigot end of the next pipe is inserted in this bell, the annular space surrounding it is calked with oakum driven home by the trowel. The bell is then sealed with cement.

The advent of the use of machinery for purposes of excavation has brought into the field another problem. For some time past it has been customary to backfill trenches by hand or by the use of teams and scrapers. Various methods have been tried, involving the use of plows, spreaders and scrapers pulled by horses. These methods were more or less satisfactory but have not greatly reduced the cost of back filling. At the present time, there is an effort on foot to use machinery of a lighter type for backfilling. As yet, there are no satisfactory machines used in Chicago for backfilling tile pipe sewer trenches altho there are several in the experimental stage. On the larger brick sewers, orange-peel grab buckets and clam-shells may be installed with economy. It is on the smaller sizes of sewers that the difficulty is encountered. A 12 or 15-inch tile pipe sewer trench, 8½ feet in depth, in ordinarily good ground is backfilled at a cost of 6 cents to 8 cents per lineal foot. This is the price prevailing for work done by teams and scrapers. In 1912, the trench for a 24-inch tile pipe sewer averaging 10 feet in depth was backfilled for 12 cents per foot. The surface of the street over the excavation is usually crowned 15 to 18 inches above its natural grade to allow for settlement. Even this crowning is insufficient in most cases and the contractors usually return after the first winter and trim up the surface of the street. The Chicago specifications require that wherever possible the trenches shall be puddled during the process of backfilling. When sewers are constructed in blocks where there are water mains or where water is available, this process of puddling is followed.

The reports of the Board of Local Improvements covering the last five years show the amount of tile pipe sewers constructed during that time and their cost, as follows:

Summary of vitrified pipe sewer constructed by private contract and special assessment.

Year.	Length in Feet.	Total Cost.
1908	187,697	$303,603.55
1909	266,888	392,284.72
1910	216,448	341,822.21
1911	284,540	415,725.74
1912	368,679	539,289.90

These figures, illustrating the amount of Chicago's sewerage work, represent, in a measure, the rapid increase of population in this great, growing city.

FAKE ADS MUST GO.

An ordinance prohibiting untrue and misleading advertising has passed the Los Angeles city council. This ordinance gives those who have been fighting for honest publicity an efficient weapon with which to force their object.

This ordinance follows closely and is modeled on the famous "Printer's Ink" statute, drawn by Attorney Sims of New York city, and already is a state law adopted in Washington, Minnesota, North Dakota, Indiana, New Jersey and Nebraska. It makes it a misdemeanor for any firm, person or corporation, to make or disseminate any assertion or fact concerning merchandise or service which is untrue or misleading. It covers every possible avenue of publicity, including newspapers, magazines, circulars, form letters, open publication, billboards, signs, labels, electric signs, window cards or by any advertising device or proclamation. A fine of from $25 to $500 or an imprisonment not exceeding 180 days or fine and imprisonment is provided for violation.

For more than a year the advertising club has been working with the backing of more than one thousand leading business men and more than half a dozen of the best civic organizations for some law which would put a stop to the fake sales that have often been carried on in Los Angeles. During the past few months nearly a score of prosecutions have been brought chiefly against fake auction sales and clothing concerns. At the present time the operations of these classes of business houses have been practically stopped and with a new ordinance in good working order it is expected that fake advertising will be put a stop to for all time.

MIXED METHOD GARBAGE AND WASTE DISPOSAL

By E. B. Stuart, Chicago, Ill.

THE description given follows the specifications of the garbage and waste disposal plant at Boulogne-sur-Mer, France, erected in 1911.

Capacity of Plant

The plant is officially rated as of 100 tons capacity in 10 working hours, one-half of the units being held in reserve; which means that the sieves separate, after defibration, 50 tons of fine siftings from 50 tons of coarse screenings, the former being destined for the fertilizer "le poudro" and the latter for gasification and combustion in the manufacture of electricity; or that more than the entire quota may be consumed in the production of electricity, without defibering or sifting. This would be an approximate capacity of 500 tons of mixed material in 24 hours. Even this latter qualification, however, is conservative, as there are four defiberers with an individual capacity of between 5 and 8 tons per hour, which would show a maximum capacity for the defiberer and sieves of 768 tons per day. Nevertheless, provision is made for combustion of the entire mass, should occasion require, so it will be seen that the plant has, by crowding every unit, an ultimate potential capacity of double this amount (i. e. 1,536 tons). These facts are dwelt upon as illustrative of the extremely rigid sanitary precautions prevailing among French cities. Boulogne-sur-Mer is, according to a recent census, a city of but 53,100 inhabitants. It is a seaport and center of the fishing industry, about thirty miles from Paris, and might, of course, be an entering place for the cholera or other plagues, which explains these extremely ample precautions.

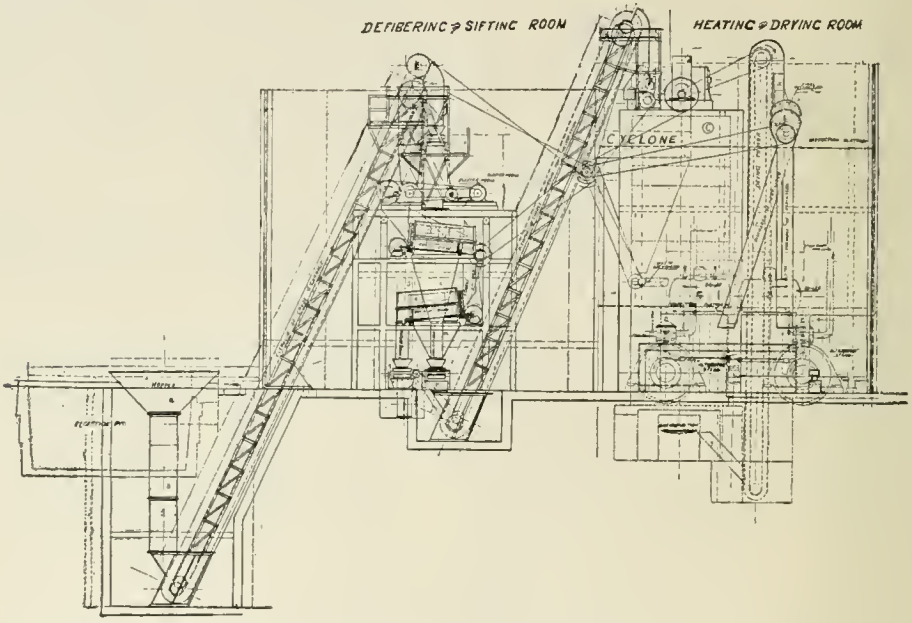
Sanitary Unloading Station

In a recent meeting of the Finance Committee of the city of Chicago the possibility of a sanitary receiving station was suggested. Mayor Harrison, who was present, expressed doubts, stating that garbage, if left standing on a platform for only five minutes after unloading, was bound to give off odors which would be caught up by the winds and dispersed to the neighborhood. Our sanitary unloading station, and this is the only system that can boast of one, as will be seen by the drawings, consists of the following:

The garbage is collected in a hermetically closed wagon or cart of a special design, which by the throwing of a lever by the driver from the seat, is caused to dump its load.

Built to and projecting from and along a portion of one side of the main building is a shed-like structure with sides and roof of metal. This shed is open at the front, facing the wagon approach. Beneath the shed is a cement pit of the same dimension (about 20 feet by 12 feet), under which, but connected by an aperture about 2 feet wide in the bottom of the pit, is a tunnel in which runs a belt conveyor. In cross section this pit (patented) has the form of a trapezium. On the outer edge of the pit is an abutment, some 6 inches in height, protected by a stout oak sill. The driver from his seat pulls the lever, dumping contents of wagon onto the sloping side of the pit below. The garbage is then easily raked down to the bottom of the pit and thru the aperture onto the belt conveyor. This gives opportunity for a preliminary examination of the material received and the elimination of large debris or wires. The garbage makes but a short trip on this conveyor, when it is discharged onto a bucket elevator, which elevates it to a height of 67 feet, where it is discharged onto a belt conveyor leading to the various units of treatment.

On the opposite side of the building is a track on which are shunted cars which bring in street sweepings, etc. via the street railway system. These cars are hauled by means of an electric cable up an inclined plane, at which point their contents are fed into a large hopper. The material unloaded here falls to the moving platform below and is carried up for treatment in the same elevator with the garbage. At the side of this hopper is a large receptacle capable, if necessary, of containing the receipts for 24 hours.



MIXED METHOD OF GARBAGE AND WASTE DISPOSAL. *Sectional drawing of design for plant, showing garbage hopper at left, defibering machine at top of center, sifting machines below, heating and drying room, fertilizer plant, incinerating furnace and boilers at right, elevators, conveyors, blowers, etc.*

It is held for emergency only. Both of these receptacles have lids which render them air tight when closed.

Conveyor System

The material is elevated some 67 feet by the bucket elevator and discharged thru a funnel onto a belt conveyor. This belt conveyor runs across the width of both the defibering and incinerating rooms and feeds five units of treatment. The belt passes thru a unique intercepting device called a "dump chariot," which, curling the belt over a series of rollers, (the whole apparatus movable along the traject of the belt) presents a discharge end. Material can thus be discharged into any one of the three funnels, each of which feeds two defiberers, or directly into one of three gas-making retorts, for conversion into gas and finally electricity.

Schoeller Crusher-Churn

The next step brings us to that wonderful machine, the Schoeller crusher-churn. The crude material from the overhead belt conveyor, by intervention of the dump chariot, falls into a bifurcated funnel, each leg of which feeds into one of these machines, known as a "broyeur." This apparatus is based on the principle of defibering by a shower of blows by articulated movable hammers fixed upon a beam turning at the velocity of 1,600 to 1,800 revolutions per minute. The hammers in their gyratory movement strike the garbage after the manner of flails; if too great an obstacle presents itself they give way, that is to say, they simply oscillate upon their

axes, which obviates absolutely all danger of fracture. The garbage is completely pulverized, but substances of a resisting nature, such as rags, pieces of wood, etc., are merely torn, being ejected at the lower end of the sieve as combustible matter.

The transformation of the garbage, both chemical and physical, after passing thru the "broyeur" is remarkable. It issues from this machine as a fine damp powder in which only exceedingly fine fibers are visible, such substances as have not been defibered being found more or less together. The intense draft of air provoked by the churning causes a complete oxidation of the particles, and the matter which went in fermented or partially fermented comes out entirely without odor and partially dried, enabling it to pass easily thru the sieves below. These results are not accomplished by any other crusher.

Production of Le Poudro

From the "broyeur" the mixed damp powder and resistant substances pass to a large perforated metal sieve, which separates the fine matter from the coarse. The coarse matter which comes out of the end of the first set of sieves passes thru a secondary process of defibering and sifting below.

The fine damp powder next passes via belt conveyor onto circular revolving steaming table (exclusive patent) and is steamed to about 120 degrees Centigrade (254 degrees Fahrenheit), all organic life being destroyed. A vertical bucket elevator carries the steamed powder to the top of the drying tower. Within the drying tower are a series of fans, revolving around a central shaft. When thoroly dry the powder falls to a distribution table beneath, from which it passes thru an elevator to the final screen, the resulting dry powder, now the complete fertilizer, "le poudro," being discharged thru jointed sheet iron pipes into one or another of a row of push cars ranged below. It is then taken to the store room, bagged, sealed, labeled and, finally, as a complete assimilable organic fertilizer, is sold in bags or in bulk at the door of the plant at retail to florists, gardeners, truck farmers, nurserymen, etc.

On emerging from the "broyeur" the damp powder occupies slightly less than one-half the cubic space required for the original garbage, the weight being equal. Practically all organic matter, whether animal or vegetable, contains in the crude state about 70 per cent. of moisture. Considerable moisture is lost during trituration in the "broyeur." "Le poudro" as it comes out of the dryer contains but about 5 per cent. of moisture, altho it assimilates a certain percentage when exposed to the atmosphere.

Individual Control

There is a general power transmission shaft at low speed, and there are two secondary shafts at higher speeds, in addition to which, each important unit or set has its reserve motor, so that incapacitation of any unit or unit of transmission can only momentarily affect the operation of other units, providing the most complete combustion is secured, delay.

Manufacture of Gas

In the incinerating room there are three upright gas-makers or retorts. The coarse material ejected from the lower end of the sieves after the final crushing passes onto a belt conveyor, is elevated on the secondary inclined bucket elevator, again discharged on the overhead conveyor and dumped by the "dump chariot" into one of the three gas-makers, where, by means of a secret process (copyrighted) it is converted into gas, which is burned on jets beneath tubular boilers, the steam from which is converted into electricity. In this way the most complete combustion is secured, in the most sanitary manner, and with additional recovery of valuable fertilizing elements from the residues.

Value of Combustible Rubbish for Electricity

One hundred tons of combustible rubbish (which has about 1/5 the calorific power of the best coal) produces 500 kilowatts of electricity per hour during 10 hours, 10 kilogrammes (22,045 lbs.) of waste treated producing one kilowatt hour of electricity.

Four hundred k.w. per hour during 10

hours (80 per cent or 4/5 of the electricity produced) remains to be sold.

Collection of Ashes

In Paris the ashes from the households (but not steam plants) are placed in the same domestic receptacles and collected with the garbage and rubbish. This would not be advisable in the United States, especially in the North, where there is a much greater volume of ashes. It might be done for the convenience of the public, in certain districts where the amount of coal was not excessive and where limited space rendered two receptacles a hardship on the tenants, enforcing separate collection for the major portion and all manufactories and steam heated apartments.

Briquettes From Cinders, Scoria, or Ashes

The cinders from 100 tons of combustible rubbish consumed produce 14,000 briquettes per day, size 22 by 5 by 5 centimeters (approximately 9 by 2 by 2 inches). The cost of manufacture in France is $3.30 U. S. gold per thousand (which includes all expenses, interest on investment and sinking fund for brick plant). These bricks find a ready market for public or private works. If sold at the plant, a saving of possibly $2.00 per ton can be figured, as against the hauling and disposal of cinders. It should be remembered, however, that by this process there are no garbage cinders as in an incinerating plant, but only from dry rubbish.

Comparison With Incinerating Plants

Aside from the fact that an incinerating plant ruthlessly destroys values (apart from a modicum of electricity), the net cost, ascertained by the Municipal Council of Paris from the report of a committee sent to investigate in various European cities, taking an average of the results obtained, for the destruction alone, after deducting revenues obtained by the incinerating plant from the sale of electricity, is 50 cents gold per ton burned, not counting the expense of collection of garbage and wastes or the expense entailed in carting away the cinders, for which there is very little demand as an article of commerce, the available sink holes around European cities having been filled up long ago. This additional expense of carting cinders away was found to be $2.00 gold per ton, a very considerable item, in view of the fact that two tons of organic waste produce one ton of very inferior clinkers, having a slight agricultural value as a low grade fertilizer and a commercial value of less than the cost of reworking it for that purpose. In a large city this item alone would run up into the hundreds of thousands of dollars per year. On the other hand, the fertilizer "le poudro," which comprises all of the organic waste, is sold at the door of the plant and this expense is not encountered. In the utilization of dry combustible waste, there is only about 5 per cent. residue and of a quality suitable for the manufacture of briquettes or for paving streets. An incinerating plant will destroy in one year values several times exceeding its original cost of construction, a vandalism worthy of the Middle Ages.

The "mixed method," due to its great rapidity and thorogh oxidation and sterilization of organic matters, is more sanitary than incineration, whether or not steaming tables are installed. This is the opinion expressed by the National Congress of Hygiene of France (a branch of the Federal Government) and by resolutions adopted by the Municipal Council of Paris.

Economy of floor space, ready accessibility to every group and unit of machinery by the workmen, and general convenience of arrangements, have been very ingeniously provided for, the three preliminary groups being on as many floors, material passing by gravitation from one to another but each protected from noise, confusion or dust emanating from the others.

Ventilation of Plant, Smoke Consumption

So perfect is the consumption of smoke and gases that none escapes thru the chimney, of which there is but one, which is more in the nature of a ventilating shaft.

All unconsumed gases arising from the burning are gathered by an electric fan in a special construction of the furnace called a "corneau" (corner), drawn thru

the drying tower and back again over the fires of the furnace, until entirely consumed by the fire or absorbed by the fertilizer; a unique apparatus called the "cyclone" precipitates the soot, which is carried into the dryer by a spiral conveyor called the "way of Archimedes," and the soot enters into the composition of the fertilizer.

This is the best ventilated garbage plant in the world. In addition to the construction being of such form as to facilitate free movement of the air, powerful ventilators are also employed.

Technical Skill Employed in Creating System

The statement is often quoted that France paid her national debt after the Franco-Prussian war by utilizing the wastes of cities. This system was originated and improved by the engineers of Paris, assisted by co-operation from all municipal departments. In fact, it is a crystallization of the best results attained in France thru scientific experimentation, profound study and practical experience.

Extraction of Grease

It has frequently been stated by American and English writers on disposal matters, that the extraction of grease constituted the principal source of profit from a disposal system. While this is not exactly correct and greater success is obtained in France by this system than in the United States by a reduction system, yet there is considerably more grease in American garbage and the matter is well worth considering. The proportion of grease-bearing matter to the whole volume of organic wastes or fertilizer material is, however, not more than one-third or one quarter. By the defibering process of the "mixed method" the cubic volume of the material which could be treated for grease extraction is reduced 50 per cent. for corresponding weight and all non-grease bearing substances are eliminated by the sieves. Subsequent drying reduces the weight to 20 per cent., giving about 10 per cent. of the volume of the defibred and dried material, to work on, as compared with the original volume. The finer the disintegration of the particles to be treated by a naphtha process and the less moisture they contain the more readily the naphtha fumes penetrate the mass. That is to say, there is an open channel for the fumes around each particle of the disintegration. On a solid substance, such as a leg of beef, the fumes will act more gradually, causing decrepitation of the outer meat primarily, and in the course of hours reaching that around the bone, but with a mass in a dry state and of perfect defibration, the fumes will pass to every portion almost immediately, the contact with the cold surface of the separated particles precipitating the molecules of naphtha, which embrace the grease and carry them by gravity thru the channels prepared. All that is required is the addition of a residual oil extractor. As grease is worth at least $2.00 to the ton of pure garbage, it is an item worth considering. Arrangements have been made for providing the very best type of grease extractor when requested.

The Object of a Disposal Plant

The primary object of a disposal plant is the sanitation of the city and subordination to municipal convenience and economics. The highest expense connected with city waste disposal is its transportation from districts of collection to the plant. A plant designed for the sole purpose of extracting grease, it being possible to extract that commodity from only a small proportion of the wastes, is not in any measure adequate to the necessities of the situation. In Chicago, for instance, incinerators strategically posted to save excessive hauls (seven miles by wagon in some instances and averaging very long) would undoubtedly be more economical for the municipality than the method employed of delivering selected garbage, only, leaving the balance more difficult to dispose of. On the other hand plants of the "mixed method" have every sanitary advantage of the incinerators and can be as conveniently disposed at stragetic points, saving this excessive cartage expense to the city. These plants dispose of effectually and yet conserve the values of everything treated which has a possible value. Conserving the organic wastes of Chicago, in the form of this magnificent fertilizer, sold at a

low price, would have a marked effect in reducing the cost of living to the population of the city, as it has done around Paris and other cities in France, by making the near-by truck farms more productive.

Market for "Le Poudro"

An explanation should be made as to the expressions which have crept into use among the chemical fertilizer manufacturers. The terms "low grade," "high grade," and "commercial," are highly misleading. An organic fertilizer does not inherently contain any larger percentage of the essential elements of fertility than were enclosed in the living substance of the constituted organism, altho the physical condensation brought about by defibration and loss of moisture renders it correspondingly richer. In the introduction of the pamphlet from which these facts are taken, appears a testimonial, highly enthusiastic like thousands of others rendered voluntarily to the French company. If an agricultural expert can obtain 25 barrels of wine from the grapes of old vines which in their prime when treated with the so-called "high-grade commercial fertilizers" yielded but two barrels, he is justified in calling it a wonderful fertilizer, and if it is wonderful it is certainly high-grade in every common-sense acceptation of the term; moreever, the people want such a fertilizer and are glad to have the opportunity to buy it, and if so, it is commercial. To use common speech expressions as technical terms, indicating certain preparations of chemicals, is dishonest in sum and substance. It is a trick of the trade and the fertilizer trade is in the hands of a few powerful manipulators, both of "the cost of living" and of simple English. There is a world of evidence to show that even common horse manure is a more valuable and complete fertilizer than most of the so-called "high grade" mineral fertilizers, but millions of horses have been deposed and the people must pay the bill because the automobile does not produce a good fertilizer. City wastes do, however, and it is a manifold crime to destroy them by incineration or fail to utilize them in the best manner, which is in the production of "le poudro." This fertilizer is sufficiently concentrated to give a good chemical analysis, but its capacity for producing results is simply marvelous.

390 TAYLOR NOZZLES *at Atlanta, Ga., operated by two 24-in. Miller Sewage Siphons.*

MOTOR TRUCKS IN MUNICIPAL CONTRACTING

By H. W. Perry, New York.

ONE of the biggest engineering jobs on which motor trucks have been used extensively is the Catskill aqueduct, to provide Greater New York with a new and adequate water supply. The Pittsburgh Contracting Co., which has the contract for construction of a section of the aqueduct more than five miles long, extending from 106th street northward thru Harlem and the Bronx, is using a fleet of thirteen motor trucks. There are three each of the White, Vulcan and Sauer trucks and seven Garfords.

Most of the fleet have very heavy plank platforms adapted to receive steel dump bodies made indepeudent of the chassis, so that they can be lifted off the platform by a crane, which swings them off the truck and up-ends them to discharge the contents at the dump.

The dump in this case happens to be a fill along the shore of the Hudson river from 116th to 129th streets, for which the Pittsburgh company also has a contract.

Debris from the bore for the aqueduct deep down under the city is brought to the base of the shaft at 106th street in dump cars, hoisted to the surface and emptied into huge hoppers fitted with chutes. From these it runs into the dump bodies on the trucks and is hauled to the river front.

HEWITT MOTOR-DRIVEN ROAD-OILER.

The trucks are operated twenty-four hours a day, exclusive of the three half-our periods when the three shifts of workmen stop for lunch. At these times the vehicles are inspected, oiled and the fuel replenished when necessary.

GARBAGE TRUCK *used by Seattle, Washington, Health Department. Pierce-Arrow Truck.*

A fair idea of the service given is obtained from the record of one truck from February 20 to March 19, inclusive. During this period of twenty-eight days, including four Sundays, the truck made 535 trips aggregating 1,592 miles. As the body has a capacity of four cubic yards, this truck hauled between 6,000 and 6,500 yards of material in the month. It made no trips on two Sundays and only nine trips on each of the other two.

From 4 to 4½ minutes are required to load the trucks with the contents of two of the two-yard tunnel cars, and only about 2½ minutes to dump the four-yard load by crane at the fill. Aside from these short waits, about the only other loss of time is occasioned by waiting for another truck to get out of the way, which does not occur often and is of short duration. Ruuning time averages 10 minutes. A full round trip occupies an average of one-half hour.

By the use of motor trucks the operators have gained a great deal of time be-

MOTOR TRUCK BODY IS REMOVABLE SKIP BUCKET. *A five-ton Saurer truck, with body handled by a crane with a derrick boom.*

sides effecting a dollars and cents saving estimated at 20 to 25 per cent. This is important, because the huge task must be finished by the end of next year. Actual records of the work of one of the five-ton Saurer trucks on this job, according to the manufacturers, show that the cost of haulage with it was 29 cents per cubic yard as against a cost of 80 cents per yard by horses, or a saving of 63¾ per cent. This truck is shown in a photograph.

Aside from the advantages to the contractors, this truck service is a great boon to the city. If the contractors used horses, they would need to use at least four or five times as many teams both day and night, with the resultant congestion of traffic and inconvenience to the public in a busy section of the metropolis.

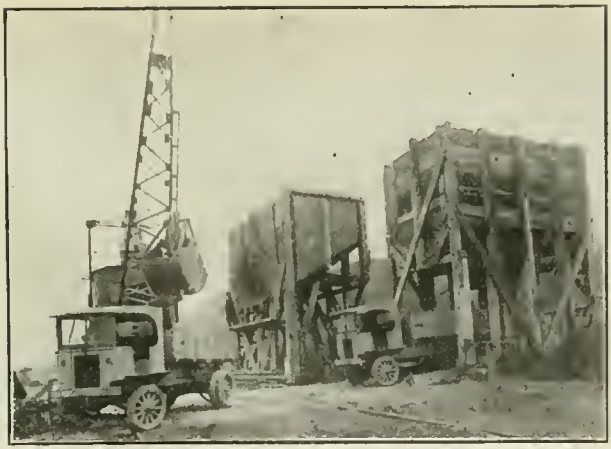
Smith, Hauser & Locker Co., who have the contract for another section of the aqueduct, nearly four miles long and farther downtown, are using a fleet of half a dozen motor trucks, also with good results. All of the cement, sand, gravel and other material and supplies for doing the concrete work are hauled by the power vehicles, working three shifts a day. The sand and gravel arrive in barges at the dock on the East river, where a crane and scoop unload them into hoppers having chutes. An average of only 16 seconds is required for loading five cubic yards of sand and 2½ minutes for loading the same quantity of gravel. A photograph shows the methods of loading from hopper and with grab buckets.

The trucks have rear dumping bodies and discharge their loads thru an opening level with the street surface. Dumping occupies about three or four minutes.

Entirely apart from the use of motor trucks for simple transportation of materials in contract work, the power vehicle lends itself admirably to many special purposes. The power plant which it possesses is frequently used for auxiliary power purposes in ways that are impossible with horse-drawn vehicles.

In street and road construction it has been found especially useful in applying crude oil and tar preparations to the surfaces. The Locomobile, Knox and Inter-

MOTOR-DRIVEN STREET SPRINKLER *with nozzles in front, preventing dust raising by wheels of the machine. Can sprinkle 80 feet width. Photograph is of machine in operation in Denver, Colorado.*



SPECIAL LOADING DEVICES FOR CONTRACTORS' TRUCKS. *Garford trucks loading from hopper and from grab-bucket handled by crane.*

national companies have all built special machines for this purpose. In and around New York a good many miles of bituminous macadam boulevards and roads have been laid. These require the application of a grade of coal tar having a large content of solids, followed by lighter grades of crude petroleum. A Locomobile truck built for this service has a large cylindrical steel tank body having pipe coils inside thru which the exhaust gas from the engine is conducted for the purpose of keeping the tar hot and in a sufficiently liquid state to flow readily thru distributing tubes under the rear end of the truck. In operation, the truck takes on a load of binder, hauls it any required distance to the stretch of road to be treated, and there applies it without loss of heat to the layers of crushed stone. A gear pump forces the liquid thru the nozzles, different sizes of which are used for the several grades of oil.

There is added economy in employment of the power vehicle in this way, because it is not necessary to establish tar and oil stations and heating apparatus so near the scene of operations as with the horse-drawn apparatus. Hauls of fifteen to twenty-five miles are not uncommon, and roads have been built as much as fifty miles from the coal tar supply. The truck makers are authority for the statement that use of the tank truck renders it possible to build bituminous roads at costs as low as or lower than that of the water-bound macadam roads heretofore laid.

Nearly thirty oil-spraying motor trucks are now used by the Standard Oil Co. in Massachusetts, New York, New Jersey and Pennsylvania. These are used principally for oiling the ordinary macadam road for the double purpose of laying the dust and preserving the road surface. Heavy crude oil is best for this purpose, and it is preferable to apply it with force so as to cause it to penetrate as deeply as possible into the road surface. The Hewitt, Mack and Saurer trucks employed are equipped with Gould rotary and Kinney eccentric pumps. These are gear-driven from the truck transmission gears or from the main propeller shaft, and provided with clutches operated from the driver's seat. The oil sprays are actuated under a pressure of from 80 to 120 pounds.

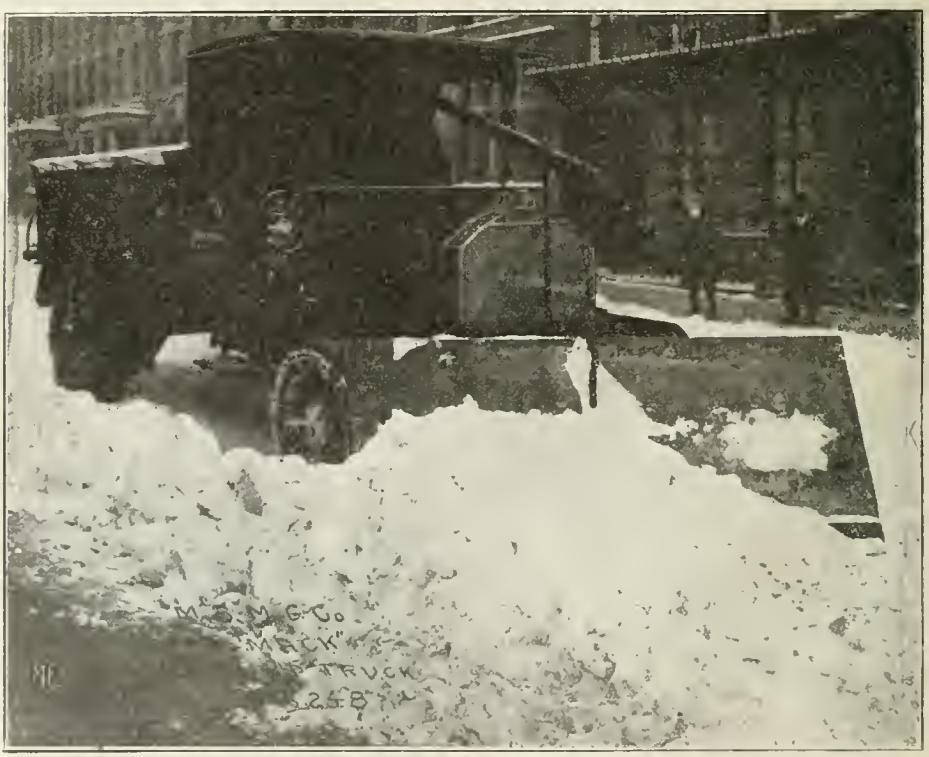
By the use of these trucks with force

ASH WAGON *of ten tons capacity used in Brooklyn, hauled by tractor.*

distribution, the contractor can use a heavier, lower grade oil than where the gravity feed is used. This oil is from three to four cents a gallon cheaper and lasts longer after application. Furthermore, owing to the faster travel of the power truck, the oil film can be spread thinner than by gravity, so that as little as one-twelfth gallon per square yard can be applied. The speed and direction of the truck can be regulated to a nicety, so as to get uniform distribution over the whole road surface. When desired, emulsified oil can be used by adding water to the oil in the tank, then pumping the oil thru a system of strainers contained in the tank. In the fall, after road oiling ceases, the tanks and spraying device can be removed from the trucks and ash, garbage or other bodies substituted for winter work. One of these oil sprays is shown by photograph.

While on the subject of streets, it is appropriate to show other special applications of motor vehicles. Self-propelled sprinklers have been in use in a number of American and European cities for years. The simple gravity system was first used, but recently this has been vastly improved upon by fitting power pumps which force the water far out on either side, so that the entire width of a street can be sprinkled at one trip. The city of Denver operates one of these motor sprinklers that waters an 80-foot street from curb to curb in one operation. The tank has a capacity of 1,400 gallons. According to Superintendent of Streets Geary, this machine saves the city $26 a day, or about $5,000 a year over horse-drawn sprinklers. It covers nearly fifty miles of streets in an eight-hour day. As shown in the photograph, the nozzles are in front instead of at the rear.

The company that has the contract for sprinkling the streets of St. Louis has purchased twelve Smith-Milwaukee motor sprinkling trucks, which are doing the work formerly done by fifty horses and which will do all the sprinkling for the whole city.



MOTOR TRUCK AS SNOW PLOW, *did the work of two hundred men.*

LOW BED GARBAGE TRUCK *hauled to dump by Knox-Martin tractor. Horses haul the rear bed from house to house for collection of garbage which when full is exchanged for an empty one brought by the tractor. Exchange easily made by jacking up front end of bed.*

Power trucks are assisting in the solution of the quick and economical removal of ashes, garbage and snow by the street departments of a number of cities. The New York street cleaning department recently began experiments to determine the adaptability of trucks to this service, and has succeeded in getting a type of truck body that permits of dumping the load off the end of the dock into scows in the river without any danger of overturning the truck, as will be seen from the photograph.

A unique plan that has been tried is the collection of garbage from house to house with a huge truck drawn by horses which, upon being filled, is left at a prearranged point to be hauled to the dump by a motor tractor. The front end of the body is jacked up and the horses and front wheels are driven away with an empty body to continue collection. The tractor, upon returning from the dump with an empty, leaves the latter and backs under the front of the full body, which is coupled on with a king-bolt and hauled away. The tractor is the Knox-Martin three-wheeled machine shown in some of the illustrations.

One of these tractors is used by the Borough Development Co., of Brooklyn, for hauling ashes from the industrial plants in Brooklyn to scows in the East river. For this work a huge steel body of twenty cubic yards capacity was especially built and mounted on a pair of 54-inch wheels shod with 7-inch steel tires. The tractor is driven by a 50-h.p. engine and in this case the pair of rear drive wheels are also fitted with steel tires. Thus the entire load, amounting to about fifteen tons, including trailer and its load, is carried on steel tires, so that the expense of rubber tires is avoided.

Cost of hauling with such an outfit has been determined to be about 10½ cents per cubic yard, or 4 cents per ton mile, as compared with 54¾ cents per cubic yard, or 20¼ cents per ton mile, with horses. These figures will vary, of course, with the conditions surrounding the use of the tractor. They include all items of operation and maintenance, such as driver's wages, fuel, tires, oil, garaging, interest, depreciation and insurance.

Motor trucks have, in a number of instances, been used for snow removal. A unique case of the conversion of a truck into a snow plow is illustrated in one of the pictures. A 7½-ton dump truck owned by Joseph Murphy's Sons, who had a contract with the city of New York for snow removal, was fitted with an improvised snow plow and put to work. The contractors reported that they could do as much work with this in a day as with 200 snow shovelers. This indicates one of the great possibilities of the motor truck that has not been developed.

YIELD OF LIMESTONE AND SANDSTONE WELLS

THE yield of wells large enough to be considered as sources of water supply for cities or towns whether large or small has been studied quite thoroly by the United States Geological Survey. The conclusions to be drawn from the facts published in various Water Supply Papers issued by the survey have been very fully stated in a paper before the New England Water Works Association by Myron E. Fuller, consulting engineer, Boston, Mass., who was for some time in charge of ground water investigations for the Survey in its eastern district.

The following concerning wells in limestones and sandstones is taken from this paper and will be of interest to water works men in many sections, where supplies, present or prospective, or additions thereto, must be drawn from deep wells running into rock strata of these classes.

Wells in Limestone

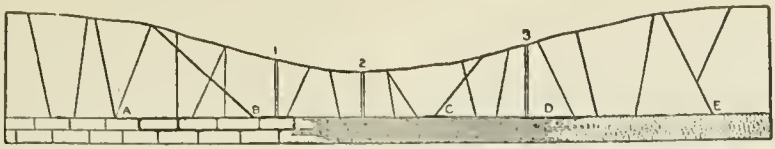
Limestones have an average porosity of about 5 per cent. and will hold about 1.5 quarts of water per cubic foot, or some 85,000,000 gallons within a radius of 500 feet of a 300-foot well, but, as in slates and granites, this is so strongly held by the force of capillarity that practically none of it is available to wells.

The available supplies from limestones come, in nearly every case, from solution passages. These are dissolved by percolating waters wherever there is an opportunity for circulation, generally along some fault, joint, or bedding plane, especially at the contact with some shaly or other impervious layer. At first the openings are very small, usually only a fraction of an inch in diameter, but there is a general tendency for the water movement to become concentrated along certain lines, with the result that tubular passages, varying from a few inches to many feet in diameter, are eventually formed. The smaller passages often form a ramifying network along bedding planes.

The largest passages are usually formed at or above drainage level, that is, above the level of the valleys into which the limestone waters drain. Our well-known caves such as Mammoth, Wyandotte, etc., are examples of this type. At great depths the circulation of water is less rapid and the passages are smaller. Nevertheless, as indicated by waterworn specimens brought up in drilling, passages a foot or more in diameter occur at depths of more than 1,000 feet. The length of the larger passages is often considerable. One passage in the Mammoth Cave of Kentucky is nearly 5 miles in length, while certain surface features, such as great sinks, indicate that passages of several, if not many, times this length may occur.

The water supplies of limestones, unlike those of most other classes of rocks, are not solely and possibly not even chiefly dependent on the presence of overlying soil or other feeders. A large quantity of water, on the contrary, passes downward

RAMIFYING CHANNELS *along bedding planes in limestone, produced by solution of lime in water, showing opportunity for circulation of water in limestone rock formations.*



SECTION ILLUSTRATING THE FEEDING OF WATER BEDS IN ROCK THRU JOINTS IN ROCK LAYERS. *Water bearing joints are indicated by the heavier lines. A, B, is water bearing area between limestone and a compact, jointed rock fed by joints at A and B. C is a water area between shale and compact jointed rocks, which has only a local circulation. D is a water area fed from a sandstone bed. E is the sandstone bed fed by joints. There is a flowing well at 1 fed from the bedding plane between limestone and compact jointed rocks, A B. The well driven at 2 was a dry hole, there being no circulation of water along the bedding plane at this point. There is a flowing well at 3 from the bedding plane D which is fed from the sandstone E.*

thru sinks or basin-like depressions connecting with the underground passages. Thru these, the surface waters enter the rock directly and without filtration. Whole streams, sometimes flowing millions of gallons a day, sometimes disappear into cavernous passages in the limestone.

From the preceding it will be apparent that the free water in limestones will far exceed that of the granite rock and the slates and shales, and will often, as a matter of fact, be sufficient to supply a well indefinitely without the aid of the usual feeder.

The ramifying networks of small passages, previously mentioned, are more dependable sources of supply than are the large passages, since they are generally of considerable lateral extent as compared with the tubular passages. A well may miss the latter entirely, even tho there may be several in its immediate vicinity, but it will rarely fail to encounter at least one of the broader bedding planes. The supplies of the latter, however, are usually more limited than those of the big passages.

Topography is a far more important factor in determining the yield of limestone wells than of those of any other class of rock. The reason for this is the open character of the water-bearing passages, which commonly permits the limestone waters to freely drain into the adjacent valleys, thus preventing the accumulation of reserve supplies. Large permanent supplies are seldom found above drainage or valley level, except where large streams of moving water are encountered. Often it will not be the valley nearest to the well that will determine the drainage level, but rather some distant valley into which the underground stream eventually discharges.

It is to be borne in mind that whenever limestone wells are considered as a source of public supplies, there is always considerable danger of contamination, owing to the entrance of much of the water into the ground through sinks and without filtration. Such waters must always be carefully watched for any sudden increase in chlorine or the appearance of bacilli coli.

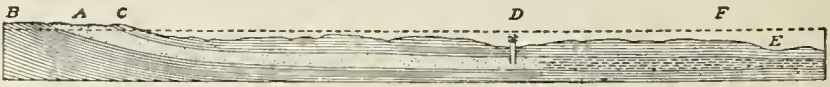
Yield of Wells in Limestone

The yield of limestones, except where very near the edge of a valley into which their waters may drain, will average not less than 50 per cent. greater than those from slates and shales. The maximum possible yield of limestone wells is many times that of wells in the latter rocks. Compared with sandstones, on the other hand, the average yield of wells in limestone is comparatively small, although individual wells encountering large solution passages may run as high or higher than the largest sandstone well. In southeastern Minnesota practically every one of the scores of public supplies derived from rock wells obtains its water from sandstone, although limestone is equally and often even more convenient of access and its water equally good from the chemical and sanitary standpoint.

The average yield of a limestone well under unfavorable conditions, as on slopes

with thin coverings, is probably about 25 per cent. less than that of a sandstone well in the same situation. Below drainage level and beneath thick coverings the average yield of limestone wells is estimated to be 50 per cent. to 75 per cent. less than wells in sandstone.

It is not considered advisable, owing to the excessively wide variations of individual wells, to attempt to show the probable average yield of limestone wells by means of a table. The foregoing comparisons will, however, afford a fair idea of the quantities to be expected from wells of this class. It may be said that, in general, limestones will afford ample water for domestic and farm purposes, and, when beneath drainage level, will ordinarily furnish sufficient quantities to supply small villages and occasionally large villages and even towns of considerable size. The yield of limestone wells is not usually materially affected by their diameters, except insofar as the size may limit the capacity of the pumps used.



SECTION ILLUSTRATING FLOW OF WATER IN INCLINED POROUS BED.
A is a porous rock stratum between impervious beds B and C, thinning out at E, so that a flowing well is possible at D but not at F. A may represent outcrop of St. Peter sandstone in Wisconsin, and D flowing wells at Cincinnati.

Wells in Sandstone

The greater part of the water in sandstone occurs, as in most other rocks, in the pore spaces between the grains, but unlike the rocks previously considered, these pore spaces are large, mostly supercapillary, and usually give up the larger portions of their supplies to wells.

Most sandstones are composed of mixtures of coarse and fine grains, which are bound together by cements of lime, silica, or iron. The extent to which these cements have filled the original pores and thus partially closed the intercommunicating passages between the pore spaces regulates, to a large degree, the freedom of movement of the water within the rock, and largely determines the yield to wells. Inasmuch as the cementing is naturally more complete where the grains and pores are small, it follows that the presence of fine material, especially silt, in sandstone is an important factor in determining yield.

In the finer and more silty sandstones which have, let us say, an average porosity of 5 per cent., only about one-fifth will be yielded to wells, while four-fifths of the water will remain permanently in the rock. In the more coarse and open varieties, whose porosity is sometimes as high as 25 per cent., about three-fifths will be yielded to wells and only two-fifths remain behind. In the first instance the yield will be equivalent to 0.3 quarts to each cubic foot of sandstone; in the second, to 4.5 quarts. The yield of a rock holding the latter quantity, if it is of any considerable thickness, is enormous. with a bed only ten feet thick there would be stored in a single acre 1,176,000 gals. Since a well in sandstone may draw from scores if not hundreds or even thousands of acres, the possibilities of obtaining large supplies for public purposes are usually very good.

Although a sandstone bed is usually more or less saturated throughout, the movement of the water, owing to the compactness of grain, may be comparatively slow and the direct yield to a well somewhat limited. Usually, however, there are more or less well-defined bedding planes in the rock, and to these the waters are delivered from the pores over considerable areas. A well encountering such a bedding plane will obtain far more water than it would otherwise secure. There is also a strong tendency toward concentration of movement within the rock along beds or layers of shale.

Joint-planes play a far less important part in determining the water-bearing capacity of a sandstone than in the crystalline rocks and slates. Nevertheless,

they sometimes afford passages for large quantities of water. This is especially true where there has been faulting along the joint-planes and the rock has been more or less crushed and broken. The exceptional yield of certain wells at Hartford, Conn., which is from three to five times that of the usual well in similar rocks in the vicinity, is attributed to such a crushed zone.

The actions of the soils or other feeders overlying the outcrops is much the same as in other rocks, but since the sandstones are themselves absorbent, the presence of feeders is not so vital.

Topography has a strong influence on the yield of sandstone wells. It is not so much, however, that the rainfall is quickly shed from the slopes as it is that the sloping surfaces cutting the sandstone beds permit the easy escape of their waters.

Yield of Wells in Sandstone

The average estimated yields of wells in sandstones of different types and under varying conditions of topography and depth are given in the following table.

importance in drilling in sandstone than in most other rocks for the reason that water enters from every point on the sides and any increase of exposed area tends to increase the rapidity of entrance of the supply. The effect is greatest in the silty sandstones. In the very open varieties the diameter is less important, as the water is often able to enter as fast as required by the pumps regardless of diameter. Large diameters are of advantage thru the increased size of pumps that may be used.

The small yield of wells of moderate depths (100 to 300 ft.) situated on slopes is due to the fact that, while the bottom of the well may be below drainage, the head of the water which determines its rate of entrance is relatively low, owing to the drainage of the supplies from the upper rocks. Under hills and upland plains this leakage is not so important, and the yield of wells is noticeably higher. Under broad plains the quantity afforded by a well approaches that given by one in the valley. Deep wells, under which head may be includ-

Estimated Yield of Wells in Sandstones.
(In Gallons per Minute.)

Diam. of Well. (Ins.)	Fine to Medium Grained and City Sandstones. Depths 100 to 300 Feet.				Coarse or Open Sandstone. Depths 100 to 300 Feet.			
	Slopes.	Upland Plains.	Valleys.	Deep Wells.	Slopes.	Upland Plains.	Valleys.	Deep Wells.
4	15	30	40	45	20	100	125	150
6	20*	40*	60*	70	25	150	200	350
8	25	50	70	85	30	200	250	500
10	30	60	80	100	35	250	300	600

*Actual averages computed for 90 wells minute respectively for slope, upland in Connecticut are 17, 43 and 64 gal. per plain and valleys wells.

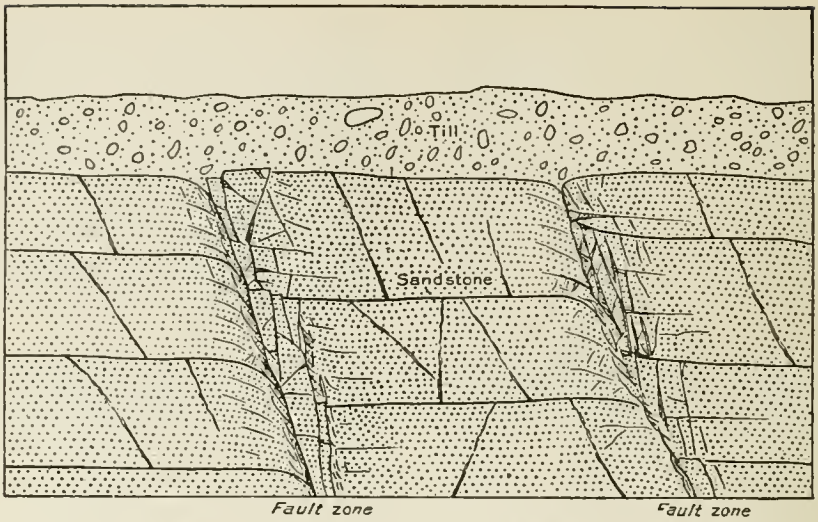
As in other rocks, individual wells in sandstone vary greatly from the average yields according to local conditions. No well in sandstone, however, unless near the immediate edge of a sharp drop, will fail to get some water, and under favorable conditions the supply may reach 1,000 gals. a minute or more, or upwards of a million and a quarter gals. per day.

The diameter of the well is of more

ed those from 300 to 1,000 ft. or more in depth having not less than four-fifths of their depth below drainage level, give still larger supplies.

The yields of the table are for sandstones of the ordinary types. The dense hard varieties, such as occur in the vicinity of Boston, in Narragansett Bay region, etc., often approach quartzites in character. In such rocks the water supplies are determined by the jointing, and vary but little in quantity from those secured from quartzites and granites.

Owing to the open character of the

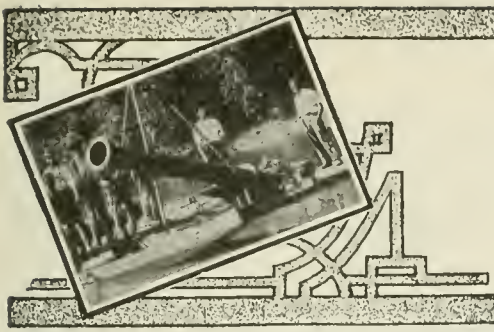


SECTION SHOWING FAULT ZONES *in Sandstone, from wells in which water can be obtained.*

rock, adjacent wells in sandstone almost always interfere with one another if the withdrawal is in excess of the inflow from other parts of the rock. The yield of nearby wells may be less than 50 per cent. of the sum of their yields when pumped separately, but one well seldom robs the entire supply of its neighbors, as is sometimes the case in granite, shale and quartzite wells. When the water-bearing sandstone is of considerable thickness and the replenishment rapid, the wells may often be pumped to their full capacity without serious interference.

The sandstones of the Connecticut Valley are medium grained and somewhat silty. Their average quantitative possibilities as sources of public supply are fairly well shown by the table, although locally the supplies will run much higher. Their mineralization must, however, be carefully considered in connection with any project for their development.

In the west, the Dakota and other sandstones furnish water for scores if not hundreds of villages and towns, the consumption of some of which reaches several million gallons per day. Over broad areas these sandstones are unfailing sources of supply where the demand does not exceed one or two million gallons a day.



EDITORIAL

CONCRETE PAVEMENTS.

Probably the most difficult of all the concrete construction problems which engineers have had to face and solve is the proper design and construction of concrete pavements. Although only a comparatively recent innovation, attended with the usual costly failures and experiments of any new type of construction, surprising progress has been made. Engineers can recall the difficulties that marked the early stages of the simplest types of concrete structures which taught the lesson that concrete is merely a structural material, subject to certain laws governing strength, elasticity, etc., and they have profited by this initial lesson.

It is obvious at a glance that the considerations involved in the construction of concrete pavements are more complex and multitudinous than in building or foundation work, but it is not generally understood as yet just where the marked differences in the two types of construction lie.

The articles in this and the preceding issue of MUNICIPAL ENGINEERING, by Morse-Warren Engineering Co., of Carlinville, Ill., are worthy of note. The authors have made a practical and scientific study of both design and construction, and the resume of their experiences and observations is not only highly illuminating, but represents one of the first practical treatises on a problem which has hitherto been subjected to various vague theories.

A PROBLEM IN PUBLIC SERVICE CORPORATION REGULATION

The Citizens Gas Company of Indianapolis as described in articles in earlier numbers of MUNICIPAL ENGINEERING, is paying 7 per cent dividends with gas at 60 cents. Its stock is voted by a self-perpetuating board of trustees so that it is not subject to manipulation. Profit beyond 10 per cent cumulative dividends on the stock must be used in retiring stock and when stock is all retired the plant belongs to the city. But profits can be kept at 10 per cent by reducing the price of gas.

The Indianapolis Gas Company is an old line company which by its own showing was not able to sell gas at 75 cents until after the 60-cent gas was a demonstrated fact, but is now claiming net profits of over $90,000 a year on 60-cent gas with still further profits in sight when the new coke-ovens are put in operation. These profits are sufficient to pay only about 1.3 per cent interest on the capitalization of the company in stocks and bonds or less than 2 per cent on the bonds, which were issued as 5 per cent bonds. It is claimed that the reduction in cost of making gas with the new coke ovens will enable the company to pay the interest on its bonds and any increase in business will then serve to pay dividends on stock unless depreciation, extensions and the like eat up the profits. It seems to be the general opinion that the capitalization of the company, $4,833,000 bonds and $2,000,000 stock is materially greater than the investment in the plant with due allowance for depreciation and obsolescence.

Certain citizens of Indianapolis at the instigation of certain officials of the Citizens Gas Co., have obtained control of the Indianapolis Gas Co. with the purpose of leasing its plant to the Citizens company and make estimates of savings in the combination which will enable the Citizens company to pay 5 per cent on the bonds and 6 to 8 per cent on the stock of the Indianapolis company. They have come before the Indiana State Railroad Commission in its new capacity as a public utilities commission, to obtain authority for the combination. This has been refused upon the terms proposed.

The Citizens Gas Company is operating under a charter which is a most successful substitute for municipal ownership and protects the city and the gas consumers from the manipulations of officers or stockholders. It guarantees low gas rates and promotes the reduction of rates at the same time that it grants ample return on capital, a maximum of 10 per cent cumulative. The low rates are possible only because the company is operating on a cash basis and its capitalization represents no water and a minimum of promotion expense. The proposed lease of the Indianapolis Company's plant puts the present control of the operations of the Citizens company in jeopardy, for it provides that the Citizens company shall guarantee certain returns upon the stocks and bonds of the Indianapolis company. If the estimated profits of the combined plants do not materialize or if the management, either ignorantly or purposely, reduces the profits of operation of the combined plants until the minimum guaranteed return on the Indianapolis company's securities can not be earned, then that company can foreclose and obtain possession of the plant. Obviously, such a contingency must be guarded against, even if large profits appear to be in sight by ignoring this danger.

QUESTION DEPARTMENT

Sewage and Garbage Disposal Methods

Can you give me information regarding the Hopcroft-Mattack process of sewage and garbage disposal on which the Sewerage and Garbage Power Company of Boston and Chicago are said to hold patents?

SUBSCRIBER.

The Hopcroft and the Matlack patents are on gas producers and details of construction thereof and they may be available with garbage and refuse as fuel. The writer knows of no installation of a plant using garbage or refuse, and letters to the company referred to, addressed to Chicago and Boston were returned for better address. Have our readers any information they can give?

Underground Receptacles for Street Refuse

The city of Chicago has just appointed a committee to investigate street cleaning methods in various cities. A suggestion is made of a street sweeping receptacle which is to be buried in the ground instead of having the cans on the sidewalks as is now the case in the loop district.

What kind of sweeping receptacles are used by some of the larger cities of this country and Europe?

D., Chicago, Ill.

An illustrated article in MUNICIPAL ENGINEERING, vol. xlii, p. 445a, shows the method of construction and operation of such removable receptacles for street sweepings and strect washings.

Segregation of Races by City Ordinance

Our city is interested in the division of the races into separate blocks, white and colored, under the recent Baltimore plan.

As a subscriber to your paper and as one interested in these matters, I would be very glad to have such information as you posses about the progress of this character of municipal legislation and what the ruling is thereon by the courts in the places where same has been tested.

M., City Attorney.

This question is referred to our readers. Are there any valid ordinances such as are described? It would seem that such ordinances must be operative only by general consent, unless, possibly, they could be put in form to be classed with the ordinances and statutes segregating races in street cars and railroad trains.

Where consent is general the segregation can be carried out without ordinances. It is perhaps easier to exclude colored persons from a territory entirely than to confine their residences to a definite area within the city. At any rate, certain cities and at least one whole county in Indiana are successful in preventing the settlement of colored persons within their limits, and have no ordinances or laws on the subject.

Results of Municipal Ownership of Public Utilities

I note a very interesting article in your issue of April, 1913, entitled "Failure and Success in Municipal Ownership," and it was particularly interesting to me as this borough, of which I am mayor, is seriously considering the advisability of putting in a municipal water and lighting plant. We have retained an engineer to lay out the plans and we expect his final report in the course of the next few weeks. In his preliminary report he states that it is entirely feasible and that the total cost would be in the neighborhood of $75,000. His plan is to sink wells and pump the water to a high point in the borough with a gas producer engine, which engine will at the same time generate sufficient electricity for street lighting as well as for private consumption. We anticipate a revenue of about $13,000 per year from all sources and we expect the costs and running expenses will be about $7,000 per year. This includes interest on bonds.

This is a small community of about 2,000 people actually living in the borough, but we have some 3,000 more living on the immediate outskirts who do all their trading in this town and most of them live nearer the heart of the borough, as far as distance goes, than do some who live in the outlying districts of the borough. However, we are figuring on putting the water mains and lighting only within our own confines and the above figure is to include some seven and a half miles of water mains and about ten miles of electric light.

While this council is very enthusiastic over the proposition there are many people in the borough who are objecting to it. It is not as though we could give a franchise for this light and water to any private company as there is none near enough to us to warrant their coming over and there seems to be no hope of any local capital coming into the field for this particular venture. My object in writing you is to find out whether there is any book of statistics published as to how many municipally owned plants there are in this country, both as to water, gas and electric light. If you know of such a book will you kindly advise me where I can purchase it or if not, will you kindly put me in touch with some one who may possibly give me this information.

Before this plant can become a fact the bonds must be voted for by the people and some of them, as above stated, are very dubious over the success of the enterprise, and I would like to give them some facts that would show that this is not an entirely new project and that it has been proved successful or otherwise in other communities.

H., Mayor, ———, N. J.

Other recent articles of interest in such cases are "Municipal Lighting Plant Operated by Oil Engine," being a description of the plant at Camden, N. Y., on p. 311 of the April number; "Municipal Plants in Small Towns," giving data about several small Kansas water and light plants, p. 371; "Eugene, Ore., Municipal Light and Water Plant," in May number, p. 427; "Pasadena Municipal Lighting Plant," showing nature of misrepresentations concerning results of municipal ownership and operation, in June number, p. 505; "Water Works of Daytona, Fla.," p. 550; "Selling Water at a Profit," a description of the Sylvan Grove (Kans.) water and light plant, p. 580.

The best list of municipally owned plants is that contained in the Municipal Year Book ($1.50), which was published some eight or ten years ago. It gives the facts concerning such matters in nearly all the cities and towns in the country as they existed at that time.

Transfers Between San Francisco's Municipal and Corporation Street Railways

Please find herewith copy of San Francisco compromise with United Railroad Co.

The option, regarding the right of the city to stop exchanging transfers after having commenced to exchange them, is a very serious one. Will you kindly give your interpretion of this?

As trust magnates play the same game from city to city, this point is liable to come up in any other city and when it means the life or death of a municipal railway, it certainly deserves consideration.

1. Note Clause 7, first line states, "Transfers shall be exchanged;" also read Clause 7, paragraph c. If the United Railroad Co. abuse their privilege or misuse their transfers in dealing with the city line, does the city give up the right to correct the United Railroad Co., except by mutual agreement," at the points mentioned along the municipal line? Note the words in Clause 7, paragraph f, "at other points"; also Clause 12, the last seven words, "except as in this agreement set forth."

2. Clause 7, paragraph d, note the words "the right is exercised by the city." If the city exchanges transfers, does the city "exercise the right" and will it have to continue to exchange transfers until January 1, 1917, or, could the city exchange transfers up to the opening of the world'a fair and then stop? See next paragraph e.

3. If the city can not refuse to exchange transfers, would the city be liable for damages if it failed to take care of all of the transfer passengers delivered to the municipal line? This is the most important point in the agreement and means the life or death of the municipal railway, as the United Railway Co. may be able to deliver passengers from thirty car lines to this one city line.

The United Railroad Co. could claim they gave the municipal line the right to run down Market street so as to have an outlet for their passengers to the fair, and the city must continue to accept transfer passengers. If many passengers, going to the fair, had to take the state railway, boats and auto buses on account of the Municipal Geary Line not being able to handle the traffic sent to it by the United Railroad Co., could the U. R. Co. claim damages for loss of tranffic and justify the claim?

Could the U. R. Co. put on auto buses to carry the transfer passengers and charge the expense to the city, after crediting the city with the two-cent fare?

A man bought an option on a piece of property, for a nominal sum, for six months; a month later he grew afraid the man would want to back out, so he paid a hundred dollars on the property; when the six months transpired he decided to lose the hundred dollars and not take the property. The court ruled he had used his privilege by this act, he had "exercised the right," and was obliged to take the property upon the terms in the option.

A man may contract to build a house in six months and reserve the right not to build it. If he starts the foundation or does any work toward it at all, he has exercised his right and must finish the contract.

Paragraphs d and e in Clause 7 are a direct contradiction to each other, also it would make a one-sided arrangement, which the law of contracts does not permit. Can the city stop exchanging transfers after having started to exchange them?

4. Would a car labeled "Valencia Street" running on Market be a Market street line?

G. H. M., San Francisco, Cal.

The paragraphs in the compromise above referred to read as follows:

7. a. Transfers shall be exchanged by the United Railroads of San Francisco and the City and County of San Francisco, at the intersection of Geary street with Divisadero street, between the Divisadero street lines of the United Railroads of San Francisco and the line of the Municipal Railway on Geary street. Transfers issued for this point of intersection, however, shall not be honored by either party to this agreement unless presented by passengers boarding the cars at this point. Transfers shall be exchanged by the above named parties at the intersection of Geary street with Fillmore street, between the Fillmore street lines of the United Railroads of San Francisco and the said line of the Municipal Railway. Transfers issued for this point of intersection, however, shall not be honored by either party to this agreement unless presented by passengers boarding the cars at this point. There shall be no compensation from any party to the other for the honoring of transfers at the intersection of the Municipal Railway with the lines of the United Railroads of San Francisco at Divisadero and Fillmore streets,

except the reciprocal privilege of transferring passengers. Transfers shall also be exchanged, should the city so elect, by the above mentioned parties at the following places and upon the following terms, namely:

b. At the intersection of Geary street with Larkin street, between the Larkin street line of the United Railroads of San Francisco, and the said line of the Municipal Railway. Transfers issued for this point of intersection, however, shall not be honored by either of the above named parties, unless presented by passengers boarding the cars at this point of intersection and also at the intersection of Geary street with Kearney street, between the Kearney and Third street lines of United Railroads of San Francisco and the said line of the Municipal Railway. Transfers issued for this point of intersection, however, shall not be honored by either party to this agreement unless presented by passengers boarding the cars at this point of intersection. All transfers from the United Railroads of San Francisco collected at the intersection of the Municipal Railway and Kearney and Larkin street lines of the United Railroads of San Francisco by Municipal Railway on its said line shall be redeemed at the end of each month by United Railroads of San Francisco at the rate of two (2) cents each; all transfers from said Municipal Railway collected at the intersection of the Municipal Railway and the Kearney and Larkin street lines by United Railroads of San Francisco, on its Larkin and Kearney street lines, shall be redeemed at the end of each month by the city and county of San Francisco, at the rate of three (3) cents each.

c. Transfers shall be issued under such traffic rules and regulations as shall be mutually agreed upon by the parties hereto, to prevent the misuse and abuse of the privilege.

d. The right, if exercised by the city, to exchange transfers at Kearney and Larkin streets, shall continue from whatever date the city elects until January 1, 1917, when further transfer arrangements may be made upon such terms and conditions as may be mutually agreed upon between the parties hereto.

e. The said city and county of San Francisco shall have the right, at any time, to abrogate this transfer arrangement, as to all of said intersecting lines, or any of them.

f. The provisions of this paragraph are and shall be without prejudice to any right which the city and county of San Francisco has, or may hereafter have, under the constitution and laws of the state of California, and the charter and ordinances of the city and county of San Francisco, to require exchange of transfers at other points along the line of the Municipal Railway.

g. The transfer privileges herein granted shall not be extended to permit transfers from Market street lines of the United Railroads to Municipal Railway, or to permit transfers from Municipal Railway to Market street lines of United Railroads, nor shall passengers boarding a Municipal Railway car on Market street going west transfer on the Kearney street line of United Railroads of San Francisco, unless the parties hereto subsequently agree thereto.

12. This agreement is and shall be without prejudice to any right which the city and county of San Francisco has, or may hereafter have, under the constitution and laws of the state of California, and the charter of the city and county of San Francisco to regulate street railroads, tracks and cars and the management, maintenance and operation thereof, and without prejudice to any of its rights under ordinances of the board of supervisors heretofore or hereafter adopted, all of which rights are expressly reserved by said city and county; it being understood and agreed that neither the Sutter Street Railway Company nor the United Railroads of San Francisco, by consenting to this provision, shall be deemed to have waived any of its rights, except as in this agreement set forth.

These questions can be settled definitely only by the court of last resort. They are mainly legal questions and so a lawyer's opinion would be the most valuable. But there are certain common-sense principles which may be applied and will give some indication of the probable nature of ultimate legal decisions, for good law is common sense and the unassailable court decisions are based on common sense.

1. Paragraphs a, c and e must be construed together, paragraph e evidently giving the city the right to abrogate the transfer arrangements at any or all of the intersecting lines at any time. The misuse or abuse of the transfer privilege referred to is doubtless that by the transferred passenger, but if the street railway company should abuse the privilege the city could require adequate rules and regulations under paragraph c or could apply paragraph e.

2. Altho paragraph e follows paragraph d, common sense would indicate that if the city elects to make the Kearny and Larkin street transfers it is bound to continue the same until January 1, 1917. This is apparently intended to prevent a failure of the city to continue the arrangement thru the time of the exposition in case it agrees to it and so prevents the street railway company making some other arrangement.

3. Kearny and Larkin streets are the only streets to which the requirement of continuous transfer service until January 1, 1917, if once established, are made to apply, and Divisadero and Fillmore streets are the only other crossings at which transfers are required. Market street lines are definitely excepted from transfer privileges to and from the municipal Geary street line. If the city cannot operate an exposition trunk line well enough to serve its own traffic and that from four cross lines, it deserves to be charged with damages whether the courts would assess them or not. The two crossings farthest down town, viz., Larkin and Kearny are subject to the division of all fares, and on the other two the city line retains all fares collected on its line, including the people returning from the exposition, and carries free only those going west from Divisadero and Fillmore street crossings. These two are not subject to the definite time limit of January 1 1917, and could be cut off at any time under paragraph e if they endangered the safety of the line or the street railway company abused its privileges on any of

the transfers. The time limit of Kearny and Larkin street transfer privileges may not be one-sided on account of inability of the company to replace the service if withdrawn by the city after an agreement had been made to continue it. The writer is not sufficiently familiar with the local situation to be competent to express an opinion on this.

4. Many lines of cars run on a trunk line of railway which may or may not bear the name of the street on which the trunk line is located. They are all classed as belonging to that line. Thus a number of lines run on Virginia avenue in Indianapolis, none of which bear that name, but transfers are given marked Virginia avenue and are good on any line so far as it runs on that avenue. At one time there was a rule that the passenger must get off the car before it left the avenue which was punched on his transfer, but this rule has been practically impossible to enforce. If the Valencia car line runs down town on the Market street trunk line it is called a Market street line, whether the courts would term it technically a Market street car or not. Paragraph g applies to Market street lines, and is not restricted to Market street cars.

Standards for Loss of Paving Brick in Abrasion Test

What reason might be assigned for the new brick rattler being a more severe test (as I understand it is) on any given make of block, in comparison with the older style rattler with the cubical shot?

Also, have there been, as yet, any percentages of loss fixed for brick of the "brick size," or do you know of any municipalities that have fixed standards of their own in regard to this point, and what percentage of loss has been fixed?

HARRY F. HARRIS,
Assistant Engineer of Streets, Trenton, N. J.

The experts were somewhat surprised to find that the new brick rattler gave a more severe test than the older style. But the results are so much more nearly uniform that they feel that the new rattler is much better altho more severe. The limits of the percentage of abrasion loss have been increased to correspond and the latest specifications call for 22 per cent. maximum loss for the best qualities of brick. A note to the specifications adopted by the American Society of Municipal Improvements provides that with medium or light traffic the engineer may specify brick which will have a maximum loss of 25 per cent. or even 28 per cent. This specification provides for a brick 2½ by 4 by 8½ or a block 3½ by 4 by 8½, and no difference is made between the two sizes in the description of the test. It is probable that the effect of the test upon the brick size will be a little more than on the block size because the bricks would occupy less space in the rattler in proportion to the steel spheres than the blocks would.

Several cities have adopted the specifications with percentage somewhere between 22 per cent. and 25 per cent. for blocks, but with no distinction for smaller sizes.

Can our readers give any additional information?

Methods of Numuerbing Lots in Plats

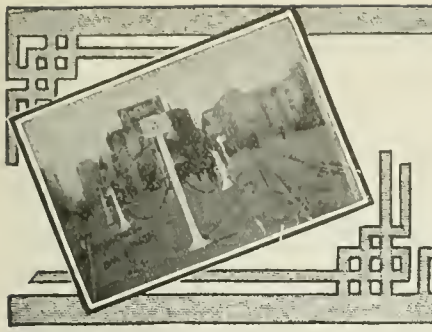
St. Louis, Mo., has the city block numbering system, where a city block, bounded by three or more streets is consecutively numbered, as the subdivisions are filed for record.

Do you know of any other city in the United States where the same or a similar system is in use?

FRANK PRESCOTT.

In Indianapolis, it is required that each addition to the city be approved by the County Commissioners if outside the city limits and by the Board of Public Works of inside or within four miles of the city limits. Each person who plats an addition uses his own method of numbering the lots. A very common method is to give each block surrounded by four streets a number, making these consecutive as nearly as possible. Each lot in a single block is given a number in a similar way so that lots are described by block number and by lot number within the block; Lot No. 8 in Block No. 2 of Jackson Park Addition, for example.

A recent paper before the Municipal Engineers of the city of New York gives a history of the taxation of real estate and the tax maps of the city. It shows that the assessors have at different times used different methods of numbering lots for their purposes, and that these numbers did not correspond with the lot numbers on filed property maps. Some hundred years ago the assessors numbered all the lots in a ward consecutively and the property owners filing the plats sometimes numbered the lots in the blocks separately and sometimes ran the numbers of the lots consecutively thru the entire plat in much the same ways that they are numbered in different plats filed in Indianapolis. About 1849 the tax numbering system was changed and the assessors' numbers were applied to each block separately so that each block was numbered independently of any other. This, of course, is simply a matter of convenience for the assessor and has nothing to do with the assignment of lot numbers by which to make transfers of the property. The system of numbering or lettering blocks and then numbering the lots in each block separately is the most convenient and also the most popular.



WORKERS IN THE FIELD

Rapid Concrete Bridge Construction

The Editor of MUNICIPAL ENGINEERING:

Sir—The Union street bridge at Danville, Va., is 1,060 feet long, 22-foot roadway. It contains about 160 tons of steel, round bars, and 3,000 cubic yards of concrete. The foundations are on solid rock and all shallow, as river currents prevented any dirt from lodging.

The design was furnished by Wilbur J. Watson, Cleveland, Ohio, and two ribs carry the floor system which is 14 inches thick without paving, that to be put on whenever the concrete floor wears enough to warrant it.

There was an old wooden bridge there and that was torn out as the new one was built, tearing out one span at a time and using the old bridge to carry the concrete to the new span, and using the old timbers for false work to hold up the concrete. There are thirteen 80-foot arches. The third arch was 90 per cent. complete when a defective timber in the bracing gave way and the span fell into the river. Despite that the structure was finished sixty-five days ahead of contract time and opened to traffic thirty-five days ahead, as forms had to stay in thirty days.

The old bridge was quite an advantage in the construction, and a dry summer was another advantage. Work was carried on night and day. A Ransome ½-yard mixer, two side dump cars and two mules included all the plant used.

Stone was shipped twenty miles; sand was taken from the river nearby; Old Dominion cement used; steel was furnished by the Carnegie Steel Co.

REINFORCED CONCRETE BRIDGE *on Union Street, Danville, Va.*

Danville is the largest loose-leaf tobacco market in the country, and a large part of the tobacco comes in by wagon over this bridge, and it was very important to get the structure finished between seasons. That result was easily accomplished, the construction requiring a little less than four months.

There have been two floods since completion of the bridge, one seventeen feet and the other fourteen feet, coming to those heights in less than ten hours.

THOMAS SHEAHAN, Contractor,
Richmond, Va.

Mr. Sheahan is a contractor of large experience, having completed seventy-two concrete structures and is evidently able to do good work at a rapid rate.

Economy of Pumping with Gasoline Diaphragm Pump

The Editor of MUNICIPAL ENGINEERING:

Sir—My information regarding diaphragm pumping engines is the result of observation and record made while resident engineer of the system of sewers and disposal plant at Franklinville, N. Y., during 1911-12.

Shortly after the trenching for the outlet sewer was started it was found that the ground water at a depth of from four to six feet flowed in such volume that hand diaphragm pumping would be very expensive and almost impossible. At my suggestion the contractor purchased a gasoline diaphragm pumping outfit from the Harold L. Bond Co., of Boston, Mass. It consisted of one gasoline engine, 3½-inch bore and 3½-inch stroke, water cooled, and connected "T"; one No. 4 Edson diaphragm pump with 20 feet of 4-inch suction hose and strainer complete, on truck.

Upon the arrival of this pump there were nine men operating three No. 3 Gould diaphragm pumps by hand, and they could just handle the flow of water if they could keep up hard pumping. This was accomplished by changing the men from time to time from the trench to the pumps.

Upon starting the Bond pump it was seen at once that the stroke of the pump was not right and it did not pump its capacity. This was remedied and the pump took care of all the water, relieving the hand pumping at once.

This pump was operated almost continuously for eight months and with repairs amounting to less than $5, not including new diaphragms. These repairs were due to two causes, one the neglect of the operator to keep the parts properly tightened, and the other the fact that the engine and connections were a little light weight for that size pump (No. 4). I understand these people now make a heavier type of engine for No. 4 pumps.

The average cost of operation was as follows, 8-hour days:

1 gal. gasoline	$0.20
1 pint oil	.15
Batteries	.15
Total	$0.50

The cost of operating the three No. 3 pumps by hand was as follows:

Nine men at $1.60 for eight hours, the wages paid at that time, amounts to $14.40, making a difference of $13.90.

This was the actual comparison as noted the day the pump was started.

I have allowed nothing for depreciation, since that would be only slightly more on the gasoline pump than on the pump operated by hand, as it would be impossible for one pump to be operated by hand continuously and handle the amount of water this gasoline pump would handle. I do not believe the number of diaphragms used would be in excess of the number required for hand pumps.

The maker of this pumping engine claims it to be "fool-proof," and he is right; it is very simple and very easily operated. It never failed to operate and do its work when given the proper care that any machine requires.

It was left at the end of a 6-inch underdrain to pump all day with no one near it except to put in oil and gasoline once or twice a day.

The contractor purchased another pumping engine later, and this was a domestic engine made in Pennsylvania. It was connected to a No. 4 diaphragm pump and was some heavier in build than the Bond engine. Its cost of operating was about the same as the Bond engine, and it did as much pumping when it worked, but the ignition and timing devices were more complicated and gave much trouble. This uncertainty of operation caused this engine to become a secondary consideration when a pump was wanted on this work. It did some valuable work, and were its operation more positive and simple, no fault could be found with it.

The one annoying feature common to both pumps was the exhausting of the batteries at a time when the pump was needed, and it seems as if this might be overcome by a magneto properly attached and housed for protection. There is no question in my mind any longer about the advantage of pumping with power-driven diaphragm pump over hand operated pumps, no matter what the quantity of water may be. And no contractor can afford to pump by hand at the present price of labor when the amount of water to be pumped begins to approach the capacity of a No. 3 diaphragm operated by one man only.

C. R. ANTHONY, C. E.,
Rochester, N. Y.

Service Tests of Oil Engine

The Editor of MUNICIPAL ENGINEERING:

Sir—We installed a 225-h.p. Diesel oil engine, direct connected to a 200-k.v.a. Fort Wayne a.c. generator, in November, 1911. We have operated this unit continuously since that time. We have never had a shutdown or an interruption of service in that time from any fault of the engine. The regulation is good, being within the guarantee of 35 per cent. at all times. Our load varies from 25 to 250 h.p.

Owing to the fact that we operate a steam unit, and thru a part of the time over peak parallel same with the oil engine, we cannot give an accurate record of the fuel cost on the Diesel alone for the straight period. During such times as we operated it alone, the fuel cost ranged from 1½ to 2½ mills per k.w., the price of oil ranging from $1.17 per barrel of 42 gallons to $1.80 per barrel. The steam unit is a 150-h.p. Ball four-valve engine, belted to a 100-k.v.a. generator.

For the year ending October 31, 1911, our total fuel bill on the steam-operated plant was $6,364 against a gross revenue of $23,000. For the year ending October 31, 1912, our total fuel bill, including the coal used on steam unit, for what time it had to run with the Diesel, was $3,528 against a gross revenue of $27,200. We had no record of the total k.w. output for 1911, hence could not make a comparison on that basis; but the increase for 1912 was considerable, with a reduction in rates, also.

Our total repair cost on the Diesel engine from November, 1911, to date, is $158.33, the major portion of this being for a set of exhaust manifolds put in lately, the first set being eaten out by the action of the circulating water and sulphur in the fuel.

This unit is shut down only once a week, on Sundays, for about three to four hours, and is never shut down thru the week.

I enclose a copy of a test made for us on this engine by A. C. Scott Engineering Co., of Dallas, last season.

J. H. Dawley,
Mgr. Hugo Ice and Light Co.,
Hugo, Okla.

The summary of the results of six tests with various loads is given in the following table,

Gas and Electric Light Rates in Large Cities

The Editor of Municipal Engineering:

Sir—The city of Birmingham, in proceeding for lower gas rates, has collected some interesting statistics, copy of which I enclose.

Romaine Boyd, City Attorney,
Birmingham, Ala.

Name.	Electric Lights. Max. Price per k.w. hr.	Steam or Water Power.	Gas. Max. Price per 1,000 ft.
Birmingham	$0.09	Steam	$1.00
Worcester	.10	Steam	.76
Fall River	.09½	Steam	.80
Oakland	.07	S. & W.	.90
Memphis	.10	Steam	1.00
Atlanta	.07	Water	1.00
Richmond	.10	S. & W.	.90
Washington	.10	Steam	.85
Louisville	.07½	Steam	.72
Omaha	.13	Steam	1.15
Des Moines	.12	Steam	.90
Kansas City	.10	Steam	.27
New Orleans	.13	Steam	1.10
Paterson	.10	Steam	.90
Denver	.08	Water	.85
Los Angeles	.06½	S. & W.	.75
St. Paul	.11	S. & W.	.95
Scranton	.09	Steam	.95

Note—Above prices are net. All plants privately owned except the gas plant at Richmond. Prices for electric lights in nearly all of these cities subject to large reductions for monthly consumption exceeding about 30 k.w. hours. All gas is manufactured except at Kansas City, which has natural gas.

To this list may be added Indianapolis,

SUMMARY OF TESTS.

Number of Test	1	2	3	4	5	6
Date of Test	4-20-12	4-20-12	4-21-12	4-21-12	4-22-12	4-22-12
Duration of Test Hours	3.00	3.00	3.00	3.00	3.00	3.00
K.W. Switchboard Reading	.....	37.42	80.23	117.5	160	180.1
Comp. Motor, Gross K.W.	.....	6.9	9.09	8.93	10	11.4
Net K.W. Output	.....	30.52	71.14	108.75	150	168.7
Efficiency of Generator per ct.	.....	85	87	90	92	92.5
Net B.H.P. Load	2.25	49.7	111.39	162.97	219.63	245.6
Speed, R.P.M.	171.1	169.1	167.4	164.4	164.8	161.9
Lbs Cooling Water Per Hour	3187	3037	4875	6300	4537	5175
Jacket Inlet Temp. F. deg.	61.8	62.4	61.9	62.6	61.7	66.7
Jacket Outlet Tem. F. deg.	115.3	127.9	115.5	118.9	156.6	173.1
Injection Air Pressure—Atmospheres	39	45.6	56	59	66	77
Fuel Oil—Pounds Per Net K.W. Hour	.....	1.25	0.7555	0.681	0.646	0.644
Fuel Oil—Pounds Per Net B.H.P. Hour	.....	0.769	0.482	0.454	0.441	0.444
Fuel Oil—Gals. Per 100 Net B.H.P. Hour	.....	10.8	6.8	6.4	6.2	6.2
Thermo-dynamic Efficiency (based upon net useful output, per cent	.....	17.4	27.8	29.5	30.3	30.2

in which two private companies are supplying gas at 60 cents, one of them paying 7 per cent. dividends and the other not paying full interest on its bonded indebtedness. The steel business in and around Birmingham seems to promise a market for coke which would make the Indianapolis plan successful for that city.

Asphaltic or Bituminous Concrete Pavements

In the article with the above title on page 334 of the April number of MUNICIPAL ENGINEERING is a table giving detailed estimates of the cost of asphaltic pavements of various mixtures, in which two or three obvious errors appear. In the make-up the headings of the two columns, "Binder Course" and "Straight Sand," were transposed as well as the order of the words. The cost of fuel at the plant in the column headed (wrongly) "Binder Course" is given as $0.044, when it should be $0.004, the same as the other mixtures, except that in the last column, which is the figure for binder course. The depth of grading for bitulithic pavement in the note marked ‡ should be 8 inches, the same as for stone-filled asphaltic wearing surface. These errors are due in part to the printed copy from which the table was taken and in part to the make-up after the material had left the editor's desk.

In a communication to *Engineering Record* criticising the original estimates presented by C. A. Mullen, the superintendent of public works at Schenectady, N. Y., from which the table referred to above was taken, George C. Warren presents some points in which he differs from Mr. Mullen. One is due to the typographical error in the table giving cost of fuel, above corrected. Mr. Warren's other objections are briefly as follows:

The 0.1 cent per square yard allowed for plant repairs on the 15,000 square yards laid per month with a $25,000 plant would aggregate only $15 a month, which is "ridiculously small."

Tools and sundries at plant and on the street at 1 cent per square yard would amount to $150 a month each, which are also considered ridiculously low, as well as the rates paid labor as compared with those paid now.

Team labor at 2.1 cents a square yard is equal to 21 cents a ton, which, with team labor at $6 to $7 per 8-hour day with loading and unloading and waiting time accounted for, is again considered too small.

Asphalt cement for painting gutters is charged at 0.1 cent a square yard of pavement for all kinds altho bitulithic gutters are not so painted, but a flush coat of asphalt cement and stone chips is applied the entire width of the pavement. Mr. Warren considers the estimate for painting asphalt gutters too low, and would add for a 50-foot width of bitulithic enough to make the cost of the asphalt cement 3.3 cents per square yard, with an addition of at least 5 cents for hot stone chips, labor and fuel, making the total cost about 8.5 cents for bitulithic instead of 0.1 cent.

The five-year guaranty bond at 5 cents more than covers the surety company's premium, but does not cover reserves for contingent liabilities under the guaranty.

Supervision, management and office charges at 7 cents a square yard amount to, say, $1,050 a month, or 2 per cent. of the value of the business done, which is stated to be very much less than the necessary overhead expense in any well-organized contracting business.

Grading per square yard at 7 cents is about one-third the actual average cost.

Concrete per square yard, 6 inches thick, 1-3-6 proportions, is given at 55 cents a square yard, or $3.30 a cubic yard, very much less than is possible under present prices of labor and materials.

The estimates allow nothing for such items as interest on invested capital, premiums for liability insurance and workmen's compensation, and allow but 10 per cent. for profit, or 11 cents a square yard, which is stated by Mr. Warren as the customary allowance by contractors for unforeseen contingencies before the profits are computed.

Milwaukee papers have been reporting the failure of the "stone-filled" asphalt pavements on North avenue, Vliet and Walnut streets, laid in winter weather late in 1911, as evidence of the failure of cheap asphalt paving. Mr. Mullen, who laid the stone-filled asphalt pavements in Milwaukee under similar specifications to those in use by him in Schenectady, points out that the three streets named and one or two others were delayed by bad weather, and, being business streets, had to be completed at once, and were laid in temperatures mainly between 0 and 32 degrees Fahr. Much of the concrete froze and oil burners were used in an attempt to thaw out and dry the surface of the concrete before laying the asphaltic layer. He points to the condition of pavements laid in good weather under the same specifications, such as Cambridge avenue, Greenfield avenue, two miles long, Twenty-seventh, Galena, Germania and many other streets, as evidence of the success of the method of asphalt paving used by him, and that the failures reported are really due to the unusually bad weather conditions during the construction of those pavements.

Wood Block Pavements in Chicago

The Editor of MUNICIPAL ENGINEERING:

Sir—Wood block pavements, in which the blocks are treated with a preservative to prevent decay and exclude moisture, are a development of recent years. The first preservatives used were chemicals, but it soon became apparent that while there were several chemicals which were very good fungicides there were none which of themselves would withstand the leaching effect of moisture. Attention was then directed to the use of the dead oil of coal tar or creosote. The satisfactory results which have followed the treatment of wood paving blocks with creosote are too well known to bear repetition. It is sufficient to say that the creosoted wood block is now the competitor of every other form of paving material.

In the business districts of our large cities, where the elimination of noise is so desirable, and at the same time without sacrificing the permanency of the paving material, creosoted wood block has a large sphere of usefulness and is rapidly replacing all other forms of paving for streets with such conditions.

The principal qualities which recommend a wood block pavement are: It is smooth, sanitary to a high degree, noiseless, durable, low in tractive resistance, comparatively low in first cost, low in the cost of maintenance and easy to repair. The principal objections which are urged against the wood block pavement are that under certain conditions it is slippery, that it exudes during the first season an objectionable oil from its surface which is tracked into homes and offices, and that the pavement often absorbs water and expands to such an extent that in places it will blow up or explode. These objections will be considered in order. It is often claimed by those supporting some other form of pavement that the wood block pavement is dangerous because it offers no foothold to horses when wet in summer or when covered with ice in winter. It is our experience that when a wood block pavement is kept reasonably clean, as all pavements should be maintained, it is no more slippery than any other form of pavement with an equally smooth surface. It is only when the pavement is allowed to become dirty that street sprinkling or falling rain produces a thin coating of slime or mud which is dangerous. Slipperiness on wood block pavements is much more dangerous in winter than in summer and more difficult to prevent. It is the result of the formation of a thin coating of ice upon the surface of the pavement. This condition of the surface is usually caused by the snow not being promptly removed, a portion of it melting and forming a coating of ice. A rapid removal of the snow will largely prevent this condition. When a pavement becomes icy in spite of all reasonable precauttions, the slipperiness may be greatly remedied by sprinkling the surface with coarse torpedo sand or ashes. In many European cities grit or finely crushed stone in sizes from the smallest up to the size of a pea is employed for this purpose with success.

The true cause of bleeding or the exudation of oil from the wood blocks during the first season does not seem to be generally agreed upon. The theories upon the subject are many and various. It is contended by some that bleeding is due to the use of a large amount of heavy gravity oil (specific gravity 1.10-1.14, which is a mixture of creosote with pitch) instead of a smaller amount of light gravity oil (1.03-1.08 true creosote) formerly used. By some it is contended that the natural expansion of the block upon heating forces the oil from those pores in the surface which are filled to excess. By others it is contended that bleeding is the result of the process of treatment; hot steam being used to remove the sap, some moisture is inevitably imprisoned, and this moisture vaporizing when the blocks become heated forces out the excess of oil. It is noteworthy that whatever the true cause of bleeding, when the light gravity oil was used during the earliest years of the wood block industry bleeding, such as we know it today, was practically unknown. There is a present tendency to get back to the use of the lighter oil, and we believe this to be a step in the right direction which will do much towards solving the problem of bleeding. Bleeding in creosoted wood blocks seldom occurs after the first season. Its amount and extent cannot be accurately predicted. It may be confined to a few weeks, and again may continue for months, during hot weather. The usual method pursued to reduce the effects of bleeding is to cover the surface of the pavement with a thin coating of torpedo sand, which absorbs the oil. It has been suggested that, after bleeding had progressed until the surplus oil had been absorbed by the surface coating of sand it might be desirable to have the surface rolled with a light roller (about ten tons), in order to force the small pieces of stone and grit into the blocks, thus forming a sort of secondary wearing surface. However, if it becomes apparent that a first treatment is insufficient, a second and lighter coating of torpedo sand is applied. Before applying the second coating the first coat is often removed by scraping. This is a matter, however, to be decided by the engineer. When treating a wood block pavement with sand to reduce bleeding, the surface must be kept sprinkled to keep down the dust.

As to the troubles caused by expansion

in wood block pavements, we believe that they are preventable. The principle that the surface of the pavement must always be waterproof should be the guiding one in constructing a pavement of this kind. No filler for the joints which will permit water to reach the under surface of the blocks should ever be used. For this reason sand and cement grout fillers are objectionable. Pitch and asphaltic fillers are satisfactory. Ample expansion joints should be provided at the curb in general at least 1½ inches in width and for wide streets 2 inches. Transverse expansion joints are not necessary. They are a source of weakness.

The creosoted wood block varies in length from 5 to 10 inches, in width from 3 to 4 inches, and is generally 4 inches in depth. Several woods, such as southern yellow pine, Norway pine, black gum and tamarack, have been used, but the one which has given the most satisfactory service is southern yellow pine. There are two general methods of laying the block, perpendicular to the curb and at an angle varying from 45 to 67 degrees with the curb. Either method gives good results. The blocks are generally laid upon a cushion of sand one inch in thickness. For this purpose torpedo sand is to be preferred to ordinary building sand, since torpedo sand will hold its position and will not gradually work away from the crown of the pavement towards the curb. Again, should water reach the sand cushion it will drain away thru the coarser sand, while it will be retained by the fine sand. An improvement upon the use of sand alone as a cushion is to lay the blocks upon a dry mortar of cement and sand, which is sprinkled with water just before placing the blocks. When wood blocks are laid next to the car tracks in a street, this cushion of cement mortar should always be provided near the rail. The shoulder of the rail should be filled compactly with a somewhat rich mixture of cement mortar and the blocks should be laid flush with the top of the rail. It is well, also, to see that the blocks are laid upon a cushion of cement mortar next to all manhole covers in the street surface. The problem of maintaining a street pavement next to the rail of a street car track which is not laid upon a concrete foundation, is very difficult, and no permanent pavement should be attempted in any street in which the street car tracks have not been put in the best of condition. It is the duty of the inspector to see that no blocks with any defects, such as checks, unsound, loose, or hollow knots, knot holes, worm holes, thru shakes and round shakes that show on the surface are used in the work. In the southern yellow pine the annual rings measured radically from the center should average not less than eight to the inch. As a pavement which can be used under a wide range of conditions, the creosoted wood block is fast demonstrating its claims to superiority.

LOUIS A. DUMOND,
Engr. of Com. on Downtown Streets,
Chicago Ass'n of Commerce.

Track Elevation in Indianapolis

The Board of Public Works of Indianapolis, Ind., has entered into a contract with the Union Railway Company for the elevation of the main tracks thru the central portion of the city and the train sheds at the Union Station, which covers a large part of the work included in the track elevation resolutions passed by the board in 1912. This elevation will necessitate the elevation of certain freight depots and yards included in the plan on which the resolutions were based, and contracts must be made with the various railroads interested to provide for the construction of these additions to the main work.

The contract with the Union Railway Company seems to be tentative, being contingent on the ability of the city to vacate certain streets and alleys which will be required, and of the company to acquire certain tracts of ground from the other railroad companies and others on which to locate additional tracks and facilities which are required. There is also a very definite expression of opinion by attorneys familiar with the former track elevation proceedings to the effect that the law will not permit the city to join in the payment for additional tracks for additional facilities for the railroads themselves, or for the laying of tracks upon the elevated areas when completed, all of which are provided for in the contract, to a greater or less extent. It is possible, therefore, that modifications in the contract must be made before it can be completed and that there will be some delay in beginning work. This would be unfortunate for the city has been working nearly twenty years for grade separation and is becoming impatient of further delays.

Repairs With Oxy-Acetylene Gas

One of the numerous ingenious applications of the oxy-acetylene gas flame is made at Dayton, O., in welding the lamp posts which were broken by the debris washed thru the streets by the Easter flood. Some 200 of the heavy cast-iron ornamental cluster light poles are reported to have been broken off. Many of them can be welded together in place by the portable apparatus, with the aid of a small derrick to set the pole back on the pedestal from which it was broken.

CONCRETE

Lake Park Bridge, Milwaukee, Wis.

By O. B. Young, Jr.

A bridge has recently been constructed over a gulley in Lake Park near Milwaukee, Wis., built entirely of concrete reinforced according to Kahn system of reinforcement. It is 216 feet long and 14 feet wide.

The abutments are 14 feet wide, 9 feet deep and run back into the earth 16 feet. They are constructed of concrete proportioned 1 part cement, 3½ parts sand and 7 parts stone and are reinforced with ½-inch round rods placed in the back and spaced 12 inches c. c.

parallel walls upon footings 18 inches wide. On the tops of these walls is placed a solid concrete railing. Between these walls is placed an earth fill.

There is 118 feet between the face of the abutments, which is spanned over with two arch ribs with a spring of 18 feet. These ribs are 12 inches wide and have a depth of 5 feet at the crown. They are constructed of concrete proportioned 1 part cement, 2 parts sand and 3 parts stone and are reiuforced with Kahn bars. The reinforcement carrying the bridge is 4 Kahn bars 1 by 3 inches made continuous and spliced with turnbuckles. Two of these bars are placed in the bot-

LAKE PARK BRIDGE, *Milwaukee, Wis.*

The bridge approach is constructed with 12-inch walls. Running back from the face of the abutments 20 feet they are built in an octagon shape and from there they run back, parallel with each other, 28 feet. These walls are 12 feet apart and are brought up from the abutments to within 6 feet of the grade by a series of steps. The octagon walls rest upon footings 24 inches wide and the

tom of the ribs and two are inverted and follow the arch 4 feet 2 inches from the bars in the bottom. In order to make the bridge as light as possible, two openings have been placed in each of the deep parts of the ribs near the abutments. These openings are placed so that upper and lower beams are formed. The lower is the above mentioned beam; the upper beam is really four beams, one over each

opening. The beam over the opening nearer the crown is reinforced with two Kahn bars 1 by 3 inches and in the beam over the opening nearer the abutments, two Kahn bars ¾ by 2 inches are used. The ribs are stiffened by stout brackets 8 inches wide placed every 12 feet.

A floor designed to carry a live load of 75 pounds is placed over these ribs. This floor is a concrete slab 6 inches thick, proportioned 1 part cement, 2 parts sand and 4 parts stone, and is reinforced with ½ by 1½-inch Kahn bars, spanning on the arch ribs, spaced 9 inches c. c. The slab is tied together with ¼-inch round rods 18 inches c. c., running full length of the bridge. A concrete balustrade railing is placed at the outer edges of the bridge between the abutments.

This bridge has a very artistic appearance and was put up in less time and at a less cost than a steel bridge could possibly have been constructed for.

Cracks in Concrete

The reinforced concrete practice standing committee of the British Concrete Institute issued letters of inquiry to all the members of the institute in order to obtain information concerning cracks in concrete and received in reply some fifty-four letters, and presented the following at the institute's thirty-sixth general meeting:

The cracking of concrete is unsightly, but is not necessarily dangerous. Cracks in concrete may be divided into two classes:

1. Surface cracking.
2. Body cracking.

Surface Cracking

In the first category the cracks are often referred to as "hair" cracks, by reason of their fineness and semblance to hairs, and occur both in plain and reinforced concrete. They are also known as "crazing" and are of very frequent occurrence. They appear to arise from the surface skin of cement mortar being richer in cement than the mortar of the body concrete, thus exposing almost a neat cement skin, which expands at a different rate on exposure to the sun's rays than the body concrete. It is worse upon the uppermost face in a mold, where the lighter and weaker particles of cement work up to the top and form a skin known as "laitance." If work be kept under water, and sometimes, if shielded from the sun, this crazing may not occur. To overcome its unsightliness, the surface skin should be removed either (1) by brushing the concrete when green with wire brushes; (2) by rubbing by means of a stone or piece of concrete and sand and water; (3) by dressing with hand or pneumatic operated chisels and hammers; (4) by brushing the surface with hydrochloric acid and subsequent washing with clean water. The last two named methods are best with completely hardened concrete.

Body Cracking

The cracks extending through the body of concrete may be ascribed to the following:

1. Faulty design and construction so far as statical resistance is concerned.
2. Expansion of cement or concrete.
3. Corrosion of embedded steel.
4. Shrinkage from setting and hardening in air.
5. Difference of temperature in different parts.

Faulty Design and Construction

Under the first head the following causes have been noted:

(a) Settlement of the foundations.

(b) Too high a stress in the reinforcement, resulting in excessive deformation.

(c) Too thick a covering of concrete, in particular where the effective depth of beams is very small.

(d) Too early removal of forms. The age of the concrete when the forms are removed must be sufficient to give the usual factor of safety due to the stresses caused by dead load and such accidental load as may at that time be anticipated. Generally the following recommendations are made, subject to the approval of the engineer or architect responsible for the works.

For mass concrete walls not subject to thrust, and where the height does not exceed two feet, the forms should not be removed under twenty-four hours. Where the wall is subjected to pressure, forms should remain in place at least a week, altho a fortnight is preferable. For mass concrete arches of more than twenty-foot span one month is recommended.

For reinforced concrete the following is recommended:

Slabs, a minimum of seven days, but otherwise, for slabs carrying only their own weight, an allowance of two days per inch of thickness, or one day per foot of span, whichever is the greater. For sides of beams, walls and columns not under side-thrust, a minimum of four days; bottoms of beams, a minimum of two weeks, though a month to six weeks may be necessary under special circumstances; for arches the time of removal of the centering is better left to the judgment of the engineer, keeping in view the ratio of rise to span and special circumstances.

If it is intended that the structure should be used for the carrying heavy weights, emergency props should be left in for such time as the engineer or architect may direct.

The foregoing periods to be increased by at least the time during which frost or rain has intervened.

(e) Defective design of forms with inadequate allowance for contraction and expansion due to variation of moisture. Dry timber may expand and crack the concrete unless wet beforehand.

(f) Careless removal of forms, which may result in cracking the concrete by shock of falling timber, or by levering and prising on the green concrete.

(g) Vibration, resulting in deficient adhesion and excessive deflection. Forms should be very rigid.

(h) Insufficient allowance for continuity, fixity and general monolithic nature of concrete work done *in situ*. Over supports the maximum degree of continuity and fixity should be provided for. Frequently cracks will be found over supports of continuous reinforced concrete beams and floor slabs, owing to the omission or insufficiency of steel there. Concrete floors are often built in chases in walls and carried over walls, others standing above, and sufficient fixity is given to cause cracks, if provision has not been made in the reinforcing. Columns and piers when built monolithic with beams will give more or less fixity to end of beams resting thereon, both at end and intermediate supports.

(i) Too close spacing of steel, so that there is no room for the concrete to get round and adhere or bond with the bars.

Expansion of Cement or Concrete

Under this heading the following causes of cracking are noted:

(a) Overlimed and coarsely ground cements which were frequently met with years ago caused expansion, to overcome which it was necessary to leave room for expansion; i. e., expansion joints. Especially was this precaution adopted around the edges of floor slabs adjoining walls.

(b) Coarse materials containing sulphur compounds, unburned fuel, oxidizable or hydratable iron compounds, unslaked lime, and other deleterious substances. Breeze, clinker and slag frequently contain sulphur and metallic iron or oxide of iron, while boiler ashes may contain both sulphur and unslaked lime (the latter derived from limestone in the coal). Some bricks contain sulphides and sulphates and lime, and should not be used broken for concrete. Old bricks also sometimes have old plaster adhering to them; the sulphate of lime may cause no trouble in plain concrete while it is kept dry, but in the presence of water reacts chemically with the aluminates of the portland cement, forming sulphoaluminate of lime, which is attended by increase in volume, and may cause blowing if in large quantity, and even a small quantity may result in cracking. Free lime in the same way will swell or contract with water. Black magnetic oxide of iron will become converted into hydroxide of iron in the presence of moisture. Indeed, any iron compounds are dangerous in reinforced concrete as likely to react electrolytically with the steel in the presence of moist air or dampness, and sulphur causes speedy corrosion.

Corrosion of Embedded Steel

Should steel in reinforced concrete corrode by reason of porosity of the concrete or the presence of deleterious substances in the coarse materials of which it is made, or by electrolytic action, the concrete cover to the bars will crack and burst off.

Shrinkage From Setting and Hardening in Air

This is probably the most frequent cause of cracking.

Concrete will expand slightly in water and contract on drying out, so that cracking is frequently not evidenced from this cause until the concrete is allowed to dry, varying usually up to two months, and in thick mass walls moisture and heat are retained for a long period and may delay cracking up to six months and even longer. It is usual to keep concrete wet for several days after manufacture in order to insure its gaining maximum hardness, and it is especially important to prevent rapid drying by sun and wind, so that the surface of concrete should be shielded against such exposure. A dry mixture of concrete shrinks less than a wet mixture, and concretes richer in cement contract more than lean mixtures. For reinforced concrete work medium wet mixtures are desirable, and therefore concrete richer in cement than 1 to 5 is not advisable for curtain walls. The coefficient of contraction of concrete on exposure to air appears to be about 0.0002 to 0.0005 at one month, and increases to about 0.0004 to 0.0006 at 1½ years. The variation recorded is between poor and rich concretes. Such contraction is usually prevented from taking place uniformly thruout; in retaining walls and pavings it is prevented by friction of the soil, in other cases by the holding of other parts. Plain concrete will usually hold together for some distance, so that contraction joints need only be inserted at intervals. The following are advised as suitable distances apart of such joints in plain concrete:

Paving, 4 to 5 feet.

Curtain walls, 10 feet.

Exposed retaining walls, 15 to 20 feet.

Basement retaining walls (not exposed) and dock walls or dams, 50 feet.

If curtain walls adjoin heavy colmns and beams, the rigidity of the latter would probably result in cracking if constructed monolithically, even if reinforced. It is

best, therefore, in such cases to provide joints adjoining beams and columns.

If concrete be laid over the joints of a thicker lower surface of concrete, the joints of the latter will most probably be evidenced in the upper surface.

Sharp augles in structural members have little resistance, and should be avoided, as also irregular shapes. The angles of window openings, unless well rounded, should be reinforced by bars placed diagonally.

As the rate of shrinkage varies with different proportions of the concrete ingredients—cement, sand, coarse material and water—variation in such proportions should be avoided as much as possible. Cracks in plastering are often due to such irregular contraction.

Partition and wall blocks, if required to be plastered soon after laying, should be quite dry before laying. If erected wet, the plaster should not be applied until they have had good time to shrink, otherwise the joints of the blocks will show as cracks in the plaster.

Large surfaces have been successfully constructed without apparent cracks by properly reinforcing the concrete and laying all at one operation. The object of the reinforcement is to break down the tensile resistance of the concrete and cause it to crack uniformly at such close distances as to render the cracks invisible to the eye. If one portion of the concrete be left over night, great care should be taken to roughen the hardened surface by tooling away; then clean by brushing with water, and apply half an inch of mortar of the same proportion as the mortar in the concrete and ram the fresh concrete well against it. Such joints will often show, even though well reinforced. In calculating the amount of reinforcement for such purpose, the ultimate tensile strength of the concrete at one month should be equated to the resistance of the steel at the yield point. Usually for a 1:2:4 concrete ½ per cent. of steel is required each way, the bars or mesh work being laid at right angles. The reinforcement should be in small sections and well disseminated thru the thickness of concrete, and a layer of bars should be near each face. So-called "distribution bars" near the bottom of floor slabs are not sufficient if cracking is to be resisted; rods should also be placed near the upper surface. Cracks frequently occur parallel to rods where "distribution bars" are not used, and also occur at right angles to main bars where continuity bars stop. Top reinforcement would avoid this. Contraction reinforcement should be in addition to the section of steel required to resist static forces.

The sudden drying out when heating apparatus is installed frequently causes excessive cracking.

Difference of Temperature in Different Parts

Considerable difference of temperature will cause cracking and should be avoided as much as possible. Heavy reinforcement is not always an effectual preventive. Most reinforced concrete chimneys, in which the internal temperature is over 500 degrees F., seem to be cracked vertically, externally, and often horizontally as well, though possibly the latter could be avoided. This cracking is probably due to the difference in temperature between the outside and the inside, which may be considerable with a cold wind blowing. A continuous lining with cavity between it and the outer shell would probably prevent serious cracking.

Great difference in the temperature between the under side and top of concrete floors is also likely to cause serious cracking. In some climates the variation in temperature is extreme and cracks will result, and even if reinforcement is provided it will be well to insert expansion and contraction joints every fifty feet.

Concrete lining and walls of ponds, tanks and the like exposed to water do not shrink by setting and hardening of the concrete, but change of temperature between summer and winter will cause cracks unless joints are provided. If plain concrete, a joint every fifteen feet is desirable; if reinforced, joints might be fifty feet apart, though closer is preferable. To prevent percolation, asphalt dowels in the joints have proven efficient.

Concrete Bins of Norfolk Sand and Gravel Plant

The accompanying illustration shows the unique equipment of the gravel plant with separate concrete bins at Norfolk, Va., which has a 500-yard sand and gravel washing and screening equipment. This plant is a model of its kind and is perfectly equipped to produce the highest grade of washed sand and gravel. It is located within the best residence district of Norfolk at the mouth of the Tanner creek about 250 feet from the James river.

The plant is not unsightly and the grounds and office buildings are carefully planned, and as the power is supplied by electric motor, little noise is produced.

The material is brought to the plant on barges from the Potomac river and Virginia Beach. A locomotive crane that is equipped with a clamshell bucket unloads the material into a hopper, from which it is elevated by a continuous bucket elevator and raised to the screens. This elevator is thirty-two feet between centers and is equipped with 16x8x11¾-

inch elevator buckets. It is seen in the background of the photograph.

The screens wash and separate the material into the following sizes—sand, grits, roofing gravel and that passing a one-inch mesh. These are discharged from the screens into the bins below and graded according to the various sizes.

About 200 feet from the screen plant proper the concrete storage bins are located and connected to the same by means of an 18-inch belt conveyer 270 feet centers. This conveyer passes beneath the screening plant, which is arranged with chutes and gates, so that the material from any one of the bins may be drawn out onto the conveyer. Beyond the screening plant the conveyer rises on an incline until it reaches a point above the concrete bins, where it returns to the horizontal and passes over the bins. A hand-propelled tripper operates on a track above the bins, and it is so arranged that material from any bin below the screening plant may be delivered to the compartment in the storage bin used for the same size of material.

The storage bin is designed so that teams may drive beneath any part, and by means of quadrant-type gates, which may be operated from the driver's seat, the wagons are instantly loaded with the desired grade of gravel or sand. As the long storage conveyer returns to the horizontal about 100 feet from the bins, it has been possible to extend the tripper back out along this part of the conveyer and thus utilize the space below the trestle for emergency storage. The concrete bins are seen in the foreground of the photograph and the conveyer and emergency storage beyond.

It is of interest to note that the surplus sand is carried from the plant by an 18-inch belt conveyer, 70 feet centers, to a pile near the river, within reach of the locomotive crane. In this way the sand may be reloaded onto barges on the river and thus delivered by gasoline tugs and barges to various parts of the city, to Hampton Roads and the nearby smaller towns.

The separate concrete storage bin is the particular feature of interest in this plant, and under this arrangement the bins beneath the screening plant may be relatively small; and, as they do not need to be elevated above the team tracks, the screening plant proper is very low. This is of particular advantage, as it thus becomes unnecessary to support the machinery at an excessive height. This arrangement of storage bins also allows greater flexibility and allows an excess accumulation of any special grade when it is of advantage to hold it; or it is possible to by-pass some of the material delivered to the plant, which does not require screening, delivering it direct from the receiving hopper to the storage conveyer and thence into any compartment reserved for the purpose.

The emergency storage space below the conveyer trestle is an advantage not possible where the screens are placed above the bins and where it is only possible to store a limited amount of each size.

While this arrangement is not suitable under all conditions, it has been found most advantageous here, and it is probable that it may be adapted to other plants where the material to be screened is delivered from a distance and where supply and demand are more relatively constant.

GRAVEL WASHING PLANT *and its concrete storage bins, Norfolk, Va.*

Action of Alkali on Cement

An important addition to scientific literature is made by Technologic Paper No. 12 of the Bureau of Standards of the U. S. Department of Commerce, of which S. W. Stratton is director. The action of salts in alkali water and sea water on cements is discussed by P. H. Bates, chemist; A. J. Phillips, assistant chemist, and Rudolph J. Wig, associate engineer physicist of the bureau.

The investigations have been under way for some three and one-half years, most of the time under the charge of the authors with chemical and physical investigations in the laboratory and field tests in sea water at Atlantic City. Many different solutions of alkalies were used, and various proportions of sand and cement were used in making the test briquets. Fresh samples and samples which had completely set were compared.

The conclusions are considered tentative, on account of the relatively short period over which the investigation has extended, but some of them are quite clearly indicated by the results. They are abstracted from the report as follows:

1. Portland cement mortar or concrete, if porous, can be disintegrated by the mechanical forces exerted by the crystalization of almost any salt in its pores, if a sufficient amount of it is permitted to accumulate and a rapid formation of crystals is brought about by drying; and as larger crystals are formed by slow crystalization, there would be obtained the same results on a larger scale, but in greater time if slow drying were had. Porous stone, brick and other structural materials are disintegrated in the same manner. Therefore, in alkali regions, where a concentration of salts is possible, a dense, non-porous surface is essential.

2. While in the laboratory a hydraulic cement is readily decomposed if intimately exposed to the chemical action of various sulphate and chloride solutions, field inspection indicates that in service these reactions are much retarded if not entirely suspended in most cases, due probably to the carbonization of the lime of the cement near the surface or the formation of an impervious skin or protective coating by saline deposits.

3. Properly made portland cement concrete, when totally immersed, is apparently not subject to decomposition by the chemical action of sea water.

4. While these tests indicated that portland cement concrete exposed between tides resisted chemical decomposition as satisfactorily as the totally immersed concrete, it is felt that actual service conditions were not reproduced, and therefore further investigation is desirable. In service the concrete extends from the sea bottom to a point above high tide, where the wall or pile would always be exposed to the atmosphere. With this condition the sea water could be drawn up the wall by capillarity, the moisture evaporating and leaving the salts, which would become concentrated, and thus possibly cause disintegration, especially if mixture is porous. An additional series of tests is now being made, in which short piles seven feet in length are being placed in sea water so that two feet of the center portion will be exposed to the atmosphere. After various periods of exposure the piles will be sawed and the various sections tested for elastic properties and compressive strength.

5. It is not yet possible to state whether the resistance of cements to chemical disintegration by sea water is due to the superficial formation of an impervious skin or coating, which is subsequently assisted by the deposition of shells and moss forming a protective coating, or by the chemical reaction of the sea salts with the cement forming a more stable compound without disintegration of the concrete, or by a combination of both of these phenomena.

6. Marine construction, insofar as the concrete placed below the surface of the water is concerned, would appear to be a problem of method rather than materials, as the concrete sets and permanently hardens as satisfactorily in sea water as in fresh water or in the atmosphere, if it can be placed in the forms without undue exposure to the sea water while being deposited.

7. Natural, slag and other special cements tested in concrete mixtures showed normal increase in strength with age both in sea water and in fresh water.

8. In the form of neat briquets most of the portland cements of high iron content, several of the cements of high or normal alumina content and one special slag cement did not show any marked difference in tensile strength whether exposed to fresh or sea water for all periods up to two years. Other cements of various compositions showed signs of disintegration after a few weeks.

9. All cements resisted disintegration in sea water better in mortar mixtures than in the form of neat briquets. In most cases the mortar briquets had normal strength up to two years' exposure.

10. The physical qualities of the cement, which depend essentially upon the method of manufacture, would seem to determine its resistance to decomposition when brought into intimate contact with the sulphate and chloride solutions.

11. Contrary to the opinion of many, there is no apparent relation between the chemical composition of a cement and the rapidity with which it reacts with sea water when brought into intimate contact.

12. Tricalcium-sulpho-aluminate could

not be formed, and therefore disintegration could not result from this cause.

13. In the presence of sea water or similar sulphate-chloride solutions:

(a) The most soluble element of the cement is the lime. If the lime of the cement is carbonated, it is practically insoluble.

(b) The quantity of alumina, iron or silica present in the cement does not affect is solubility.

(c) The magnesia present in the cement is practically inert.

(d) The quantity of SO3 present in the cement up to 1.75 per cent. does not affect its solubility, but a variation in the quantity present may affect its stability by affecting its rate of hardening.

14. The change which takes place in sea water when brought into intimate contact with the cement is as follows:

(a) The magnesit is precipitated from the sea water in direct proportion to the solubility of the lime of the cement.

(b) The sulphates are the most active constituents of the sea water and are taken up by the cement. Their action is accelerated in the presence of chlorides. No definite sulphate compound was established.

(c) The quantity of chlorine and sodium taken up by the cement is so small that no statement can be made as to the existence of any definite chloride or sodium compound formed with the cement.

15. The SO3 added to a cement in the plaster to regulate the time of set is chemically fixed so that it will not go into solution when the cement is brought into intimate contact with distilled water.

16. Metal reinforcement is not subject to corrosion if embedded to a depth of two inches or more from the surface of well-made concrete.

Patent on Concrete Dam

The Ambursen Hydraulic Construction Co., of Boston, has appealed from the recent decision, May 17, 1913, of the United States District Court for the Southern District of New York, which denies novelty in the claims of the Ambursen patent, ressiue No. 12,246, of 1904, saying that "the complainant's concrete dam is substantially a reproduction in concrete of an old and familiar style of timber dam. The flooring is supported by buttresses with spaces between. The complainant's concrete dam is claimed to have, and I am satisfied from the evidence it has, various points of superiority over the solid masonry dam. The cost is low. The material is plastic. It forms a solid mass without joints. But that is a feature of all concrete construction. The claim is that under this patent the complainant has a monopoly of dams made of concrete after an old style of wooden dams. The general rule is, of course, that the substitution of one material for another is not invention. Undoubtedly the complainant's form of concrete dam has many advantages; but they seem to me to result simply from the natural qualities of concrete, and not from any newly discovered qualities. If this patent is valid, the first maker of a concrete house or bridge or sidewalk was entitled to a patent for the thing made."

Design for New City Hall for San Francisco

The photograph of a part of a rough model of the successful design for the new San Francisco city hall shows the central tower and main entrance. Further study of the design and working out the requirements of the various departments has materially changed the original design and the architects, Bakewell & Brown of San Francisco, are now busy upon the detailed plans.

ROADS AND PAVEMENTS

The Brick Road the Cheapest and Most Economical

S. C. Andrews, an attorney of Conneaut, O., spent two or three months in an investigation of the road conditions in his county, Ashtabula, the results of which were presented at a good roads meeting held last month in Conneaut, which was illuminating in a number of ways.

He first showed the lack of system in accounting which provides no record of work performed or place or purpose of using materials purchased; which does not separate expenditures in road and bridge building and maintenance funds so that any reasonable approach to accuracy can be made in compiling figures of cost.

In the discussion of this part of the report the fact was brought out that there are several laws, not altogether consistent with each other, under which roads can be built and maintained. The principal laws are as follows: The Braun law is for use of counties building their own roads, the county paying 40 to 60 per cent. of the cost and the remainder being divided between the township and the property within a mile of the road. The Gehrett law, which has just been re-enacted and put in full force again, provides for the division of the cost of road building between the township and the property within a mile of the road, 40 to 60 per cent. on the township and the remainder on the property. Applications for such roads are made to the county commissioners and they order the construction. The State law provides that the State will pay 50 per cent., the county 25 per cent., the township 15 per cent., and the abutting property 10 per cent. of the cost of the improvement. The new Half-Mill law makes a levy of that amount to raise the State's portion of the cost of road construction and will raise about $3,250,000 a year. One-fourth of this amount is to be spent on the main market roads and the remainder is to be used in equal shares in aid of road build-

MACADAM *on Center Road near Conneaut, O. Note heavy dust and cloud raised by automobile.*

ing in the counties of the state, about $30,000 a year for each county acting under the State law, or by the State in the county in case the county does not act, in which case the county would get only half the length of road.

A difference of opinion as to the possibilities of action under these laws arose, a county commissioner contending that a single township which was taxed up to its limit for roads built under the Braun or Gehrett laws, especially the latter, would prevent the raising of the $30,000 required to be raised by the county under the Half-Mill law in order to get the full benefit of it. The State Highway Commissioner, however, showed how the money could be raised by bonds and these bonds and their interest could be paid under the provisions of the Smith law without violating any other state law.

It is evident that the complexities of the laws are too much for many county commissioners and that many of the errors complained of are due to lack of financial and legal ability of the county managers.

The laws do not give much attention to road maintenance, outside of the state aid roads, and Mr. Andrews reports pay so low and the qualifications of road inspectors and foreman so low, in the absence of any general method of fixing them, that there is little hope of improvement under the present laws. The pay of county commissioners is only $135.70 a month and no allowance for expenses. That of township trustees, who have charge of maintenance of roads not built under the laws, is not more than $150 a year, so that the lack of competent road men extends all the way from the general supervisors and administrative officers to the workmen in the field.

Perhaps the most important subject covered in Mr. Andrew's report is the relative cost of roads of different materials. His report is lacking in some details on account of the lack of full records and the distribution of items of expense among different funds, so that they are hard to collect according to any desired system. The road costs are probably fairly comparable among themselves, tho they may not be comparable with those in other counties or states. A few roads did not pay engineering expense. Others paid varying amounts from 3 to 12 per cent. Widths of improved surface vary from 9 to 28 feet. The cost of each road was computed per foot of width and per mile of length as perhaps the nearest to a comparable basis.

Macadam roads 9 to 16 feet wide cost from $506.54 to $762.33 per mile for each foot in width. Nine-foot roads cost from $4,560.89 to $5,273.25 per mile. Fourteen-foot macadam roads cost from $7,950.65 to $10,672.59 per mile.

Tar macadam roads 16 feet wide cost $13,874.90 per mile or $867.18 per mile per foot of width.

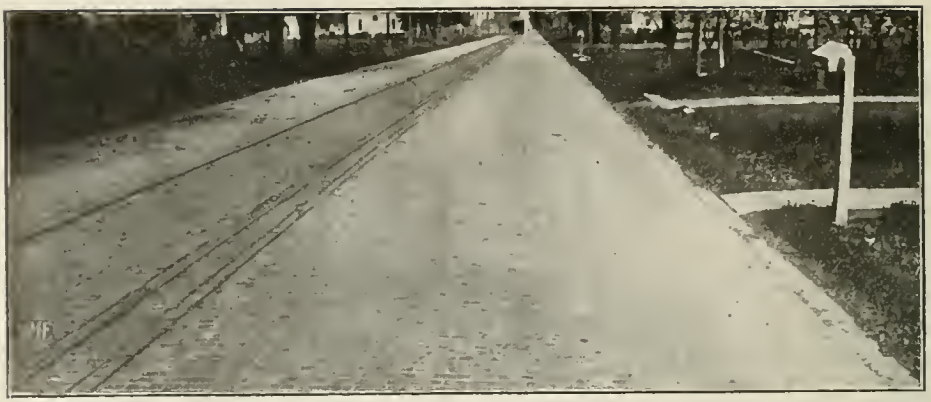
Tarvia X macadam road 26 feet wide cost $26,229.53 per mile or $1,008.23 per mile per foot of width.

Concrete roads 16 feet wide cost about $9,600 per mile or $598.57 to $609.11 per mile per foot of width.

A brick road 28 feet wide costs $26,613.44 per mile or $950.48 per mile per foot of width.

No figures of cost of maintenance are available. Three of the macadam roads, finished in 1908, 1909 and 1910, each 14 feet wide are now being resurfaced at an average cost of about $215 per mile per foot of width. If we estimate the average life of these pavements at 3½ years, the maintenance cost is practically $6 per mile per foot of width per year, or $84 per mile per year for the 14-foot roads in addition to any expenditures that may have been made in maintaining these roads during their life-time. As nearly as can be computed from the figures in the Andrews report, the average cost of

MACADAM ROAD *near Conneaut, O. Note depth of rut.*



BRICK ROAD *with cement filler near Conneaut, O. Note perfect surface.*

maintaining the 40 miles of improved road included in it is about $130 a mile a year; or practically double the cost per mile per foot of width per year of the resurfacing done on the three roads, the average width of macadam roads being about 11 feet.

The brick road has had no repairs except those made by the street railway, replacing bricks laid with asphalt filler between the rails, when the vibration of the tracks under car traffic raised the bricks from their bed.

On one of the macadam roads resurfaced there is a stretch of 6 per cent. grade which has been resurfaced with tar treatment twice in nine months.

The accompanying photographs show three of the roads included in the Andrews report. The first photograph, taken May 5, 1913, is of Conneaut macadam road No. 1, one mile south of the city limits. This improvement, 1.34 miles long and 14 feet wide was constructed of macadam in 1907-1908 at a cost of $631.93 per mile per foot of width. This pavement is in process of resurfacing using a tar treatment in 1912-13 at a cost of about $215 per mile per foot of width, as above stated. This makes the total cost of the road, including 1913, $846.93 per mile per foot of width, plus whatever may have been expended upon the maintenance of the road between 1908 and 1912. This road is very dusty at present and needs the resurfacing altho it has a reasonably smooth surface.

The second photograph, taken May 5, 1913, shows Conneaut macadam road No. 2, 2½ miles south of the city limits. This improvement, 2.07 miles long and 14 feet wide was constructed of macadam in 1908-1909 at a cost of $762.33 per mile per foot of width, and is the highest cost macadam road in the county. This road is in much worse condition than the one shown in the first photograph and will be resurfaced at once under the estimate of $215 per mile per foot of width, as above stated. This makes the total cost of the road, including 1913, $977.33 per mile per foot of width.

The third photograph, taken May 5, 1913, shows the Conneaut brick road, which is the Ridge road from Woodworth Road east to the Pennsylvania State line. It was built in 1908-1909 of shale brick on natural soil foundation with grout filler, 1 cement to 1 sand, except the area between and just outside the street car rails, which has an asphalt filler. The pavement is 1.52 miles long and 28 feet wide and cost $950.48 per mile per foot of width. It has cost the county nothing for repairs to date, and from the appearance of the photograph this statement will be true for many years.

Comparison of the cost to date of these pavements shows clearly the greater economy of brick. Altho its first cost is 25 to 50 per cent. higher than the macadam roads of about the same age, its lack of maintenance cost brings it down to the same or less cost at the end of three or four years' use, and from this time on the brick pavement will be the cheapest. This does not include the greater interest charge on the investment in the brick pavement, which would equalize this difference.

The brick pavement has never been swept and its freedom from dust, as compared with the macadam pavement, is evident. Convenience, continuity of service, ability to carry greater loads and more rapid travel, all count to the advantage of the brick pavement. It is also more than probable that a macadam pavement in the same place would have demanded greater expenditure for maintenance than those given, because of the presence of the street car tracks and the consequent tendency of traffic to form ruts.

Municipal Asphalt Repair Plant at St. Paul, Minn.

In the budget for 1912 $15,000 was appropriated in the general fund for the purchase of equipment for making street paving repairs. In February bids were called for for a portable asphalt plant, and later other equipment was purchased under competitive bids. The entire plant installed under this appropriation and in use in 1912 consists of a Warren Bros. portable asphalt plant, one 8-ton asphalt steam roller, one scarifier, one Lutz surface heater, one fire wagon, one gyratory stone crusher, two portable melting kettles, six 2-yard steel-lined asphalt wagons, four ¾-yard concrete spreaders, one set of curb cutters' tools, nine asphalt rakes, testing scales and the necessary small tools. While the plant is a portable one, it has been located centrally to the work to be done and on trackage, thus simplifying handling of materials, and has been kept constantly in the one place.

The plant was put in operation April 25, and during the season was worked a total of ninety-two days; 19,428 square yards of asphalt pavement were turned out, 15,040 square yards of this being cut-out work and 4,388 square yards burner work. There were 5,458.63 square yards of asphalt put in for paving contractors in repairing asphalt pavements under guarantee. Of this 2,363 square yards were cut-out work and 3,095 square yards burner work. The total cost was $6,012.96, which was billed against the contractors and collected.

There were 2,902 square yards of asphalt put in for the Street Railway Co. and billed against it, the cost being $4,363.50; 1,636.44 square yards of asphalt were put in for public service corporations, costing $2,944.48 and being billed and collected; 1,029.53 square yards of asphalt were put in on bridges on which the city maintains the wearing surface. This cost $1,961.57 and was charged against the bridge building and repair fund at $1.65 per square yard, excepting the Rice Street bridge, which was charged at $2 per square yard on account of special work and additional depth of asphalt. One hundred and twenty-seven square yards of asphalt were put in for miscellaneous parties and charged to them, this cost totaling $281.21.

The repairs to asphalt pavements out of guarantee and paid for out of the street and sewer fund, amounted to 6,981 square yards of cut-out work and 1,293 square yards of burner work. This repair work cost the city $7,163.50, or an average of 86 cents per square yard.

The operating crew at the plant consisted of one foreman, one engineer, one tank man, four laborers and a night watchman. Four teams were employed in hauling asphalt from the plant to the work.

The street crew was made up of one foreman, one timekeeper, one roller man, two rakers, two tampers, one smoother and one cement man putting in new pavements, two shovelers, six scrapers and two teams removing and hauling the old paving. The total expense was divided as follows:

Labor

Operation of plant	$ 2,535.00
Unloading material	255.62
Removing old paving and puting in new	7,116.48
Hauling asphalt	780.40
Shelter shed and misc.	178.98
Total expenditure for labor	$10,866.48

Material

Asphalt, Trinidad Lake	$ 6,507.46
Fluxing oil	1,927.61
Fine sand	960.00
Coarse sand	182.00
Fuel oil	858.96
Coal for plant	420.35
Stone dust	465.00
Crushed stone	306.24
Cement	297.00
Road roller fuel	162.50
Wood	34.00
Advertisement	11.60
Resetting radius curb	32.83
Freight	1.15
Surface heater	382.48
Auto hire	40.00
Waste	7.13
Kerosene	22.74
Tool repair	54.52
Equipment	26.32
Small tools	99.18
Oil and supplies	88.28
Miscellaneous material	60.05
Total expenditure for material	$12,947.40

Total expenditure for labor and material, $23,813.88.

Material on Hand at Asphalt Plant, January 1, 1913

6,825 gal. fluxing oil	$ 518.51
50 cu. yds. fine sand	50.00
15 cu. yds. coarse sand	7.50
24,000 lbs. raw asphalt	372.00
350 gal. fuel oil	26.21
600 empty dust sacks	60.00
250 empty cement sacks	25.00
½ cord maple wood	4.00
1/3 bbl. cylinder oil	9.50
1/3 bbl. engine oil	3.50
25 lbs. cup grease	2.50
2 bxs. Garlick packing	2.50
6 pcs. asbestos pipe covering	4.04
1 lb. acorn packing	.75

35 fire brick	10.50
1 bundle tar paper	.60
Total material on hand	$1,097.11

Total labor and material used, $22,716.77.

SUMMARY

Total labor	$10,866.48
Total material	12,947.40
Total cost of labor and material	$23,813.88
Charged to outside parties	$13,591.70
Charged to bridges	1,961.57
Material on hand	1,097.11
Total credits	$16,650.38

Total cost of city work, $7,163.50.

In figuring the above costs no depreciation of plant or interest is charged, but all small tools have been charged against the work.

Prospective Opportunities for Highway Engineers in a National .. Highways Department

By Charles Henry Davis, C. E., President National Highways Association, before the Society for the Promotion of Engineering Education.

To begin at the end—the opportunities are unlimited! But why? We grew as a nation during the scientific growth of the world, so to speak. Prior to this period other and older nations had provided themselves with highways. Methods of intercommunication, up to the limits of apparent needs, are essential to the well-being of any people. People, like water, stagnate if confined to one locality. They must run and play, like the brook itself, or become sluggish and dull —to themselves as well as to others. Hence before the coming of steamboats, railroads, the printing press, and electricity roads were built by the older nations so that their peoples could move. Roads were the only means they had of intercommunication. But we came to be a nation when these modern methods of connection and communication were being perfected. As these means were more rapid and as our country was so large, their development pushed one side the building of roads. We were too busy for road-building and our need therefore was not then so apparent. But now we are, as a nation, awakening to the lack of our forethought, the pressing necessity and the vital importance of road-building. This is evidenced by some fifty major good roads or allied associations, five hundred state and local organizations, the same number or more automobile clubs, and some one hundred thousand road officials thruout the United States. We are probably now spending directly and indirectly over $500,000,000 per annum on the roads of the country. And yet we have less than ten per cent. of our 2,300,000 miles improved—or with the semblance of improvement, such as it is. What will we spend to make them all good roads, and to maintain them? No one can tell. No one can foresee. But it is safe and conservative to predict over $1,000,000,000 per annum during the next twenty-five years, or an investment exceeding that on our steam railroads. And then we shall only have made a beginning.

To carry conviction of the coming of this vast expenditure and the economic necessity therefor: It has been estimated that more than five billion tons of freight per annum pass over our highways. Of this more than half would probably go over a system of national highways. It is estimated that the present average haul is a little under ten (10) miles and that the cost is about twenty-three (23) cents per ton per mile. This cost should not exceed eight (8) cents per mile on a good road. In other words, at least one dollar and a half ($1.50) should be saved on every ton moved on our highways. Thus the total saving from good roads staggers the imagination. Our railroads carry two billion tons of freight per annum. If, instead of the above estimate, we assume that only an equivalent tonnage passes over our highways, then the saving per annum would be $3,000,000,000 on a system of good roads. The probabilities are that the saving would be far greater.

The value of farm real estate and buildings is $35,000,000,000 for the United States. Two million miles of improved highways will increase land values some $10,000,000,000, or approximately an increase of one-third above present values. Does this indicate we cannot afford to improve all our roads? There are 6,500,000 farms. This means that the average increase of value for each farm would be $1,500. At $100 a year per farm we would have a sum of $650,000,000 per annum with which to improve our highways. This would build 130,000 miles a year at $5,000 per mile, or less than twenty years within which to improve all our highways. In this time they would many times pay for themselves in savings and also in increased land values.

Such figures could be multiplied. It is therefore beyond any reasonable doubt that the nation will spend the moneys needed to produce such magnificent returns in both usefulness and economy.

But there is another side of even greater importance—civic, moral, and educa-

tional—which far transcends the material and commercial part of the problem. We cannot have good schools in the rural districts without good roads. And we must have good schools.

The relation of good and bad roads to illiteracy is indicated by the following facts:

Illiteracy is eleven (11) times greater in the South Atlantic States than in New England, while the percentage of improved roads (such as they are) is about one-fourth. Similar figures for the Pacific and West South Central are: fourteen (14) times greater illiteracy, while the percentage of improved roads roads is less than half (½) as much. The illiteracy in rural New England is one hundred and forty (140) per cent. of that of urban population, while in the South Atlantic States this increase is nearly three hundred and fifty (350) per cent., due to the lower percentage of improved roads.

The children of today are the electors, the representatives, the senators, the judges, one of them the President, of tomorrow. The population is increasing by leaps and bounds. If education means liberty, and if poor roads mean illiteracy or worse, have we a right not to build good roads, even if they would not pay for themselves well within the generation which builds them?

And of equal importance—our people cannot get "back to the land" unless we have good roads. They must get back for us to live as a nation!

The evidence is therefore overwhelming that greater sums are to be spent on the roads of the United States within the next generation, than on any other activity of the body politic. They will be used by all. They will be paid for by every one of us. They will be free to all of us. They will be of untold, daily advantage to us.

All this being true, is it not apparent that the opportunities are unlimited? In being unlimited there is a serious side to it. Will all the educational institutions, including the National Government, be able to educate highway engineers rapidly enough to supply the need therefor? We think not. Decidedly not! Therefore the greater the facilities offered for such education the better for good roads, whether these facilities be private or public, state or national. We cannot obtain, in time for our needs, the education and therefore the knowledge we need properly and economically to build the good roads of the coming generation. The opportunities for the highway engineers are therefore unlimited in or out of a National Highways Department.

Wide Tire Legislation Demanded

A meeting of leading state highway commissioners and the manufacturers of horse-drawn wagons and motor-driven trucks is the suggestion of Chairman George C. Diehl of the A. A. A. National Good Roads Board, who contends that the time has arrived when those interests can advantageously discuss the drafting of suitable legislation governing the width of tires and the weight of loads. After an interchange of views a committee could prepare laws the passage of which would be practically assured when put forward by the chief highway officers of the various states.

"Many states have enacted laws which endeavor to regulate the width of tires of vehicles, but unfortunately there has not been strict enforcement of these regulations," says Chairman Diehl. "The width of tires is one of the important factors in highway construction and maintenance. Narrow tires, especially during the wet season, form ruts in improved roads and in many instances, where the roads are weak, break thru the surface, with the subsequent rapid destruction of the highway.

"One great difficulty in enforcing wide tire ordinances with horse-drawn vehicles has been that while less traction is required with wide tires, on slippery clay or hilly roads it is very difficult in wet weather to manage a horse-drawn vehicle with wide tires, owing to its tendency to skid and slide into the ditches. Instances are frequent where in a journey a farmer must drive over miles of slippery road and only have a few miles of improved highway, in which case he would naturally prefer to use narrow tires for the entire distance, rather than to attempt the use of wide tires over the slippery section of the road.

"There is no question that protection and economical maintenance of improved highways require that narrow tires should be discarded, and ordinances must be enforced which will prevent their use on main traveled highways which have been improved at great expense. If a vehicle owner desires to use narrow-tire wagons or slippery roads, he must be absolutely prevented from using the same tires on improved roads. Equal, if not greater, damage can be done to the highway with tires of insufficient width on motor trucks. There is no state where wide tire ordinances are drawn which relate to both horse-drawn and motor-driven vehicles, or where a scientific attempt has been made to prepare such ordinances or where a strict enforcement is had.

FIRE AND WATER

Sanitary Significance of the More Common Constituents of Water

By George A. Johnson, before the American Water Works Association.

Eliminating from discussion for the time being all forms of bacterial and other microscopic life, let us first consider the evidence bearing on the sanitary significance of the more common constituents of water, as determined by chemical analysis.

Physical Features

Under this heading, of course, come taste and odor, color and turbidity. What effect on the health of the consumer have these features as applied to water?

A water heavily charged with mud will naturally possess an argillaceous or clayey taste and odor, the same being intensified on heating. This is not agreeable to many. Assume that a water contains on the average 100 parts per million of suspended matter. In a year's time an adult will consume in this way about 1/7 pound of such matter, or some 5 pounds in a lifetime. This quantity will go a considerable distance toward the "peck of dirt" a person is supposed to eat in the course of a lifetime, but in itself cannot be considered as having any sanitary significance.

Water which is naturally highly colored sometimes possesses a slight astringent taste, but such coloring matters, being vegetable stains for the most part, can have no deleterious effect on the health of the consumer.

Some waters possess offensive tastes and odors due to growths in them of certain higher forms of microscopical life, and due to the liberation by them of essential oils in the process of their development or decay. These are relatively small in quantity, and cannot in themselves actually cause serious disturbances in the body of the consumer.

Some waters are so heavily polluted with certain industrial wastes as to give them a highly objectionable taste and odor. Probably the most prominent in this line are waters tainted with the waste liquors resulting from the destructive distillation of wood and coal. Creosotes, phenols and similar compounds are especially offensive and far reaching. A very few drops of creosote will impart a marked taste to a gallon of water.

At Marquette, Michigan, trouble of this kind was encountered, and only overcome by moving the water works intake far out into Lake Superior, and locating it some 50 feet or so below the surface. It will be recalled that the waters of Lake Superior are not subject to periodic overturn, as are those of the remaining Great Lakes.

In some streams in Pennsylvania this sort of water pollution has become a serious nuisance. Warren, Pennsylvania, has experienced a great deal of trouble of this kind, and likewise New Castle, Pennsylvania.

At the latter place the creosote liquors came from the by-product coke plant of the Carnegie Steel Company, located at Farrell, on the Shenango River, and some 20 miles above the intake of the New Castle water works. The waste liquors from this plant amounted to some 160,000 gallons daily, and the amount of creosotes and phenols to a maximum of about 200 pounds daily. Now it so happens that the minimum daily flow of the Shenango River at Farrell is about 15,000,000 gallons, therefore the creosotes equalled under these circumstances .000228 grain per gallon, or .0039 part per million. The theoretical dilution was 1:9000. A strong creosote taste and odor was imparted to the water, and this, as was anticipated, could not be removed by moderate aeration, treatment with lime and sulphate of alumina, and subsequent rapid sand filtration. The difficulty was only overcome when the Steel Company impounded all of the wastes of the coke plant, and afterwards used them for coke quenching, in which process, of course, they were vaporized.

Now as to the sanitary significance of such substances in water. Let us assume that the 200 pounds of creosotes and phenols were all pure creosote. The

medicinal dose of creosote may safely be taken at 10 drops. To get a single medicinal dose from water polluted as above it would be necessary for one to consume over 30 gallons of the water. Furthermore, creosote is not a cumulative poison, but is rapidly excreted thru the pores of the body, leaving nothing behind.

Finally then, those physical characteristics natural to many surface waters which lend to them an unsightly appearance, or an objectionable taste and smell, are of actual injury only in so far as they may affect the individual imaginatively. This feature is not to be disregarded, however, for there is no doubt that many thousands of people actually have thought themselves into the grave. One of the first lines of common-sense water logic, therefore, is that drinking water shall be free from perceptible quantities of color and turbidity, and that it shall possess no disagreeable,. or actually foreign, tastes or odors.

Organic Matter

Under this heading, altho it may not be precisely correct, we will include all nitrogenous matter, such as free and albuminoid ammonia, nitrites and nitrates; and carbonaceous matter, such as "oxygen consumed" and the like; in short, all organic matter found in water, both of vegetable and animal origin, whether derived from human or animal excrement or from the wash of woods and fields. It is necessary at this point only to eliminate living bacteria from discussion. They will be considered later on.

There is nothing in the complex compounds of organic matter commonly found in water supplies which need give alarm to the water consumer. Prior bacterial decomposition of such matters, doubtless, is instrumental in producing certain ptomaines, which in sufficient quantity would exert in some degree a toxic effect on the human organism. But while such conditions might be conceived of in sewage, in water, even after it has received sewage up to the limit of its powers of digestion, the dilution of such substances is too great to warrant serious consideration being given to this feature.

While it is aesthetically repugnant to conceive of drinking water supply originating from crude sewage, yet sewage, if thoroly treated with chemicals and filtered, may be made perfectly safe for human consumption. Consider in this connection the purification of Bubbly Creek water at Chicago. This creek, receiving the sewage of some 400,000 people, is in a practically continuous state of fermentation. In its raw state it is slate-color and putrescible, and contains at least five times as much nitrogenous, and twice as much carbonaceous organic matters as the ordinary run of polluted raw river waters. The bacteria always range around 1,000,000 per cubic centimeter, and forms of sewage bacteria are always present in relatively large numbers. By coagulation, sedimentation, sterilization with hypochlorite of lime followed by rapid sand filtration, a clear and sparkling effluent was obtained during a test of the purification process referred by the writer in 1908. The filtered water contained 8 parts per million of oxygen consumed, 2 parts of free ammonia, 0.14 part of albuminoid ammonia, 23 parts of chlorine, but under 50 bacteria per cubic centimeter, and B. coli rarely ever present.

A short time after this purified water was turned into thte stockyards the matter became the subject of litigation, the city contending that it was illegal to use water derived initially from such a foul source as Bubbly Creek, even though it was later purified. The testimony for the defense brought out some interesting points bearing on the potability of such purified waters, which, while free from dangerous bacteria, still contained high amounts of animal and vegetable organic matter of known sewage origin. It was shown that the waters of the Seine at Suresnes and Ivry, and of the Norder Elbe below Hamburg, where Altona obtains its supply, are in more or less the same class of foully polluted waters, but are purified and made safe for human consumption, even tho they still contain in large quantities organic matter of sewage origin.

The prosecution endeavored to establish the fact that, even tho the water was made pleasing to the eye and rendered practically free from bacterial life, the filtered product still contained dissolved organic matter in such quantities as would be likely to exert a toxic influence on persons drinking such water continuously. Evidence to combat this view was furnished, referring particularly to the report of the National Board of Health, Senate Doc. Second Session, 47th Congress, 1882-1883, Volume 1, part 2, page 201; Second Report of the Royal Commission on Sewage Disposal of Great Britain, 1902, page 27; Report of the Massachusetts State Board of Health, 1890, page 537, an dother published documents.

Professor E. G. Smith of Beloit College testified that in his opinion the water as delivered from the Bubbly Creek filter plant was a more safe and usable water supply than the city supply derived from Lake Michigan; and Prof. John H. Long, a noted toxicologist, and a member of the so-called referee board, a commission appointed by President Roosevelt to study and report on the effect of the food preservatives, testified

that the filtered water did not contain substances which are to be considered harmful, and that, while he was unable to state an exact maximum permissible limit, the amount of dead organic matter still remaining in the filtered water was well within the safe limit. Furthermore, he stated that there is absolutely no difference between organic matter coming from sewage and that coming from decayed vegetables, that the protein matters are the same, and that they yield the same decomposition products.

Still further evidence is furnished by the testimony of Count Le Couppey de la Forest, Secretary of the Commission d'Etude des Eaux of Paris, France, given in the case of the State of Missouri vs. the State of Illinois and the Sanitary District of Chicago, 1903, pages 4829, et seq. There he stated that the effluent of the sewage farms of Paris is drunk exclusively by all of the 200 to 400 workmen, and close watch on their health is kept by regular city physicians who report weekly upon the health of these men; and during the past twenty or more years, in fact since these sewage irrigation farms were first started, there has occurred among these workmen no case of typhoid fever, or cholera or dysentery or any other of the diseases which are water borne.

Without evidence to sustain the point how can it be concluded otherwise than that dead organic matter, in such quantities as are found in water, has not the slightest actual sanitary significance? Again we are forced to fall back upon the aesthetic phases. One who first looks at a foully polluted and stinking body of water naturally rebels at drinking it even after purification, and when he knows it cannot harm him. If he had no knowledge of its source he would accept it without protest. But how do the results of chemical analysis actually benefit him or anybody else when recording the free and albuminoid ammonia, the oxygen consumed, the nitrites and the nitrates as being present in this and that amount?

Chlorine

The effect of chlorine on the public health, in the quantities and as found in water, is nil. The average individual consumes at the table each day many times as much salt as is ever present in a drinking water supply.

Hardness

It is the contention by some physiologists that those constituents which make water hard are deleterious to the public health. In some cases this view would seem to have considerable merit. The traveler is unpleasantly reminded of the effect of abruptly changing from a soft to a hard water, and vice versa, but there are no statistical data to prove that in general the hardness of a water has any clearly defined effect one way or the other on the public health. Altho it is strongly maintained by some that various specific diseases such as urinary calculi, goitre, etc., are produced by the continued use of vary hard waters, the confirmatory data to prove out this view are lacking. It is much more probable that the effect of hard waters is really restricted to simple gastric and intestinal disturbances, which are temporary only in their effect.

Iron

The chief objections to iron in a water supply, from a sanitary standpoint, are its undesirable taste and appearance, when present in sufficiently large quantities. Where it comes from the source of supply it can readily be removed by aeration and filtration; and when it comes from the service pipes thru the corrosive action of carbonic acid and other agents, corrective measures have to be taken before the water is delivered into the mains.

The sanitary significance of iron in water may be considered as nil, for when present in large amounts its undesirable taste would preclude its use.

Organisms Found by Microscopical Examinations

Water supplies are examined for the higher forms of microscopical life as a routine procedure in but few places. In the majority of cases such examinations are carried on only at times when the water possesses objectionable tastes and odors, the endeavor at such times being to locate and identify the organism which is causing the trouble. Knowing the kind of organism, it is relatively easy to destroy it at its source thru chemical treatment.

Where water works systems include large impounding reservoirs or storage basins such examinations may, to advantage, be carried as routine, except, perhaps, during the cold winter months. With a continuous record of the kinds and numbers of microscopical forms common to a water it is possible to anticipate by prompt chemical treatment a heavy growth which otherwise would result in the production of offensive odors and tastes.

Aside from aesthetic objections due to the appearance of "slime" in the water, and of offensive tastes and odors, due to the growth of such microscopical life, and all preventable by promptly instituting proper chemical treatment, such higher forms of microscopical life have no sanitary significance.

Bacteria

It is the almost universal custom in water works laboratories to make daily analyses of the water supply for total numbers of bacteria; in some the number of bacteria developing on special media at body temperature is also determined; and in many presumptive tests for B. coli are carried as daily routine. There is no question that the results of bacterial analysis are of more value in determining the hygienic quality of a water than the entire chemical and microscopical data laboriously and expensively obtained.

Bacteriology is a comparatively new science, and by no means a precise one. It is a matter of common knowledge that with the methods of analysis of today the bacteriologist can isolate and positively identify specific disease germs only with the greatest effort and difficulty, and even then it is of primary importance that their number and virulence be also known before the water can justly be condemned. The finding in water of germs known to be associated in one way or another with disease-producing germs furnishes valuable circumstantial, but nevertheless indefinite, evidence.

Sometimes the presence of comparatively large numbers of bacteria in water has no sanitary significance whatsoever. This is true even when the evidence is quite positive that among the number are forms whose best known habitat is the intestines of man and domestic animals. Waters draining uninhabitated areas, and therefore far removed from opportunities of pollution, particularly where the areas drained are swampy, sometimes show high numbers of bacteria.

The test for B. coli is the usual way the present day bacteriologist has of ascertaining the relative purity of waters, also of forming a judgment of the purity of an individual water. This organism is the normal inhabitant of the intestines of man and some domestic animals, and of course is always present coincidentally with the typhoid germ when a person is suffering from that disease. It is equally true that in the vast majority of cases where B. coli is found in water the typhoid bacillus is absent. Therefore, where B. coli is found the inference that B. typhosus is or may be present furnishes circumstantial evidence purely, yet because the typhoid bacillus may be isolated from water only with the greatest difficulty, and because the reverse is true of the colon bacillus, the presence of absence in water of the latter organism is looked upon as the surest index of sewage pollution available to modern water bacteriology.

But the colon bacillus found, even if the number of coli be large, may have come solely from the excreta of domestic animals, or even from fish, and such animals do not suffer from typhoid fever. Again, the bulk of the coli may come from the excreta of perfectly well persons, and where a water is contaminated with city sewage this is always the case. So its presence in water merely furnishes evidence that it has been polluted with animal excrement; that typhoid fever germs may be present, but no proof that they are.

A water may contain a few stray coli and yet be perfectly safe to drink, for they all may have come from domestic animals. Furthermore, soli may have entered a water months before, even accompanied by typhoid germs; but both of these organisms, being out of their natural habitat in water, quickly become attenuated and lose their virulence.

In judging a water by the presence in it of B. coli, it is necessary to possess a knowledge of the number of these germs and of their vitality, in order that it may be known whether the pollution is recent, in what relative amount, or if it occurred a long time in the past and the germs found represent the attenuated survivors of those which entered the water originally.

The numbers of bacteria in a water and the results of the test for coli have a definite, tho limited, value. High numbers of bacteria and the persistent appearance of B. coli can only mean a dangerously polluted water. Not that it is actually unsafe to drink all of the time, but that at any time it may become so. Low numbers of bacteria and no coli can only mean a water of high sanitary purity.

The absolute value of bacteriological examinations is difficult to express except in this manner. B. coli may be present in a water every day for weeks and months on end and the water be perfectly safe. At Cincinnati, Ohio, during the year 1912, daily tests showed B. coli in the filtered supply three times out of every four when 100 cubic centimeter volumes were examined; and once in every twenty times where one cubic centimeter quantities were tested, yet the typhoid fever death rate in Cincinnati for that year was 7 per 100,000 people living, one of the lowest typhoid death rates recorded for that year among the cities of the world. An ordinary drinking glass will hold about 250 cubic centimeters of water, so according to the results of the Cincinnati analyses B. coli was probably present in every glass of drinking water, yet the typhoid fever death rate among its consumers was exceedingly low.

Ordinary city sewage contains about 500,000 B. coli per cubic centimeter, hence, on a basis of 100 gallons per capita daily sewage flow, one person will dis-

charge 190,000 million coli each day. On the basis of a stream flow of 3 cubic feet per second per 1,000 population contributing sewage, such water would contain immediately after the entrance of the sewage 26,000 colon bacilli per cubic centimeter, or about 6,500,000 in every glassful. Increase the above stream flow 50 times. Assume that 90 per cent. of the coli are removed by purification of the sewage before it enters the stream and the number of coli in a stream so polluted become 52 per cubic centimeter, and about 13,000 in every glassful. Then further assume that 90 per cent. of these coli are eliminated shortly after entering the stream, thru such agencies as osmosis, etc., and there remain 5 coli per cubic centimeter, or some 1,250 in a glassful of water.

Now take, for purposes of discussion, a city wherein the annual typhoid death rate is 10 per 100,000 population living. About 100 persons would suffer with this disease to cause this death rate. Assume that the cases are evenly distributed thruout the year and that the number of typhoid bacilli discharged by them is equal to the number of coli. Assume also, of course, that no attempt is made to disinfect the typhoid excreta, and that it all enters the stream in a crude state; then in water so contaminated and diluted, as described above in the first case, and before the numbers of bacteria are reduced by purification or other agencies, there would be 26,000 colon and 4 typhoid bacilli per cubic centimeter; and the ratio between the number of coli and the number of typhoid bacilli, under these assumed conditions, which are intended to be the worst one is warranted in imagining, would be about 7,000 to 1.

The purpose of the above discussion is to show, in an elementary way, that B. coli may be present in water in large numbers but not necessarily be accompanied by typhoid germs, or prove that the water is dangerous merely because it does contain coli. It is a sure index of fecal contamination and indicates danger. Would it not be better to conclude, therefore, that water showing coli in any number, at any time, and under any set of conditions is to be considered suspicious and to require treatment? Coli will always be found where the typhoid germs are, even tho the latter are infrequently present when the colon bacillus is found.

From a strict hygienic standpoint there are no "pretty good" waters. A water is either polluted or it is not. If polluted it must be purified. The danger may be, and is, greater in proportion to the degree of sewage pollution, but any degree of danger is not admissible in the public water supplies of the present age.

Public Well and Water Supplies From Gravel and Sand

Two exhaustive papers on underground water supplies for municipalities have been presented recently, which contain much of value on the subject of wells in gravel and sand. One of these is the paper on "Quantitative Estimation of Ground Waters for Public Supplies," by Myron E. Fuller, presented March 12, before the New England Water Works Association, and the other on "Basic Principles of Ground Water Collection," by Charles B. Burdick, presented June 26, before the American Water Works Association. The following concerning supplies from sand and gravel is collected from the two papers, first abstracting from Mr. Fuller:

The water-bearing capacities of sands and gravels are largely a factor of their porosities. Where the grains are all of the same size, the porosity is independent of their diameter. For instance, the large number of small pores in a sand are equivalent in volume to the comparatively small number of large pore spaces in a gravel. When, however, small grains fill the spaces between larger ones, as sand grains between the pebbles of a gravel, the porosities are much reduced. Altho the size of grains in uniform sands or gravels does not affect the porosities, their arrangement is of great importance. When arranged in the loosest possible manner, they have a porosity of 47.6 per cent.; where arranged in the most compact manner, the porosity is only 26 per cent. The actual porosities in nature are usually about midway between the two. In laboratory tests the porosities of uniform sands and gravels are found to be about 35 per cent., and of mixed pebbles and sand, which is the ordinary condition of our gravels, about 30 per cent. In nature the materials are subject to pressure, due to the weight of the overlying deposits, equal to about one pound for every foot in depth. This pressure produces a compacting, according to laboratory experiments with pressures of from 0 to 100 pounds per square inch, made under my direction by Mr. L. C. Creminant in connection with some recent investigations for the city of San Francisco, of from 5 to 8 per cent., reducing the actual probable porosity in the ground by an equivalent amount.

When water is withdrawn from a sand or gravel, a certain quantity remains behind as residual moisture, and is not yielded to wells. The quantity thus withheld varies with the size of the grain from 5 per cent. in the gravels to perhaps 20 per cent. in the finer sands or those approaching silts in texture. It

still further reduces the effective porosities or available storage. The reductions due to compression and residual moisture are shown in the following table. The last column shows the quantities of water actually available.

Effect of Porosity Deductions

(Per cent. of volume.)

	Porosities of Loose Materials. (Laboratory Tests.) Per Cent.	Loss of Porosity Due to Weight of Overlying Material. Per Cent.	Loss Due to Water Remaining in Pores. (Res. Moisture.) Per Cent.	Effective or Available Porosity. Per Cent.
Gravel (mixed sand and pebbles)	20-30	5-8	4-8	10-20
Sand (medium to coarse)	30-40	4-6	6-10	15-25
Sand (fine and very fine)	30-40	0-5	10-25	5.20

The quantity of water stored in the sands and gravels is not the only thing that must be considered. The real determining factor in a permanent supply is the rate of replenishment. In an inclosed basin or other area not receiving outside supplies, replenishment is mainly from rainfall. The whole rainfall is, of course, not available, large deductions being necessary for evaporation and surface runoff.

In sand and gravel deposits receiving contributions from outside their own areas, as is the case of most of the formations in stream valleys, a determination of the rate of underflow is necessary to fix the quantity of accessions from sources other than rainfall. When replenishment occurs from a stream flowing over the surface of the deposits being drawn upon, a still further determination, that of downward percolation, is necessary.

A fairly exact determination of the rate and volume of underflow can be made by actual measurement by the electrical method devised by Prof. Charles S. Slichter, of the University of Wisconsin and the United States Geological Survey. In brief, the method consists in sinking four 2-inch wells in the form of a fan or triangle, the apex of the system being toward the supposed direction from which the water is moving. Common salt or ammonium chloride is inserted in the apex well and the time required for penetration into the other wells taken by electrical recording apparatus or determined from water samples taken and tested at short intervals. The rate of percolation from streams is best determined by the Slichter method used in conjunction with a pumping test.

Where a direct test is not made, it is possible to form an approximate idea of the rate and volume of underflow by computations based on temperature, size of grain, porosity, head, etc. It may be stated that size of grain and temperature are factors of the greatest importance. The flow thru a sand whose effective size of grain is 1 mm. or about 1-25 inch, which may be regarded as a fairly coarse sand, is 10,000 times that thru a clay whose particles have an effective size of .01 mm. The flow at 70 degrees is about double that at 32 degrees. Again, the movement of water thru sands of the same size of grains varies with the nature of the packing, a sand with a 40 per cent. pore space having a movement of 2.6 times that thru one of similar grain but with packing giving a 30 per cent. porosity.

Something of the actual rates of underflow movements under ordinary conditions is indicated by the following table:

Common Rates of Underflow

(After C. S. Slichter.)

(Gradient or Head, 10 Feet Per Mile; Porosity, 32 Per Cent.; Temperature, 50 Degrees Fahr.)

Materials.	Diameter of Grain in Millimeters.	Movement in Miles per Year.	Movement in Feet per Year.	Movement in Feet per Day.
Fine sand	0.2	0.01	52.8	0.145
Medium sand	0.4	0.04	216.0	0.6
Coarse sand	0.8	0.16	845.0	2.3
Fine gravel	2.0	1.02	5,386.0	14.76

Yield of Isolated Areas of Sands and Gravels

The yield of wells in isolated areas is dependent upon the inter-relation of rainfall, evaporation, and run-off. Estimates of the quantities afforded under conditions prevailing in New England are given in the following table, in which part of the figures are the estimates of the New York Commission on Additional Water Supply, based on extended and detailed studies on Long Island in 1903.

Yield of Isolated Areas of Sands and Gravels

Rainfall. (Inches.)	Estimated Evaporation. (Inches.)	Estimated Run-off as Flood Flow. (Inches.)	Estimated Ground-water Increment. (Inches.)	Yield per Acre per Day. (Gallons.)	Yield per Minute per Ten-hour day. (Gallons.)
35*	17*	3*	15*	1,116	1.85
37½	17	4	16½	2,228	2.03
40	17	5	18	1,339	2.22
42½*	17*	6*	19½*	1,451	2.41
45	17	7	21	1,562	2.60

The foregoing table shows the limitations of yield where there are no ground water additions from outside sources. Under such conditions the yield is essentially dependent upon area.

Yield of Non-Isolated Areas of Sand and Gravel

When additions from outside the area normally tributary to the wells occur, the supply is largely dependent upon the rate of underflow. The rate of movement in materials of different sizes has been indicated in a table given above. The following table shows the volumes that may be anticipated under varying conditions of porosity and movement.

The figures in the table show the underflows passing given points before pumping has begun. They are the quantities which will normally be available to wells without material readjustment of replenishment conditions.

After the pumps are started, the movement of the water will be greatly accelerated because of the increased gradient resulting from the local lowering of the water table near the well. Moreover, since a heavily pumped well intercepts and utilizes the underflow over a much greater cross section than 1,000 square feet, the supplies actually available at a given point will ordinarily be several if not many times the quantities indicated in the table. The amount and permanancy of the supply that may be withdrawn in excess of the normal underflow will be regulated by the readiness with which replenishment by downward percolation from surface sources occurs. This, as previously indicated, is best determined by combined pumping and underflow tests.

The storage capacities of sands and gravels are very great, and in many instances, even tho the wells may be drawing from them faster than the water is replenished, the supplies may be sufficient to make it possible to postpone for many years the installation of more expensive systems, with their attendant in-

Transmission Thru Sands and Gravels

(Per One Thousand Square Feet of Cross-section.)

Head, 10 feet per Mile; Temperature, 50 degrees F.

Porosity. Per Cent.	Relative Flow.	Flow in Gallons per Minute.
Medium sand. (Effective size, .4 mm.)		
26	1.00	0.4
28	1.28	0.5
30	1.61	0.6
32	1.99	0.8
34	2.43	1.0
36	2.93	1.2
Coarse sand. (Effective size, .8mm.)		
26	1.00	1.6
28	1.28	2.1
30	1.61	2.6
32	1.99	3.3
34	2.43	4.0
36	2.93	4.8
Fine gravel. (Effective size, 2. mm.)		
26	1.00	10.2
28	1.28	13.1
30	1.61	16.4
32	1.99	20.5
34	2.43	24.8
36	2.93	30.0

creased cost of maintenance and higher interest charges. The following table shows the available supplies in materials of varying porosities after the necessary deductions for compacting and residual moisture have been made. The compacting and residual moisture factors are based on experiments made for the writer by L. B. Cheminant in the laboratories of the Department of Public Works of San Francisco in connection with ground-water investigations for that city.

Storage in Sands and Gravels

(Gallons per One Thousand Cubic Feet.)

Porosity by Laboratory Test. Pct.	Probable Porosity of Undistributed Material. Pct.	Deductions for Residual Moisture. Pct.	Available Porosity or Storage Capacity. Pct.	Storage in Gallons per 1,000 cu. ft.
Very fine sand (approaching silt).				
30	30	25	5	374
30	30	20	10	748
35	30	25	5	374
35	30	20	10	748
40	35	25	10	748
40	35	20	15	1,122
Fine sand.				
30	30	15	15	1,122
35	30	15	15	1,122
40	35	10	29	1,496
Medium sand.				
30	30	10	20	1,496
35	30	10	20	1,496
40	35	10	25	1,870
Coarse sand.				
30	30	7	23	1,720
35	30	7	23	1,720
40	32	7	25	1,870
Gravel (mixed with sand).				
20	16	6	10	748
25	21	5	16	1,197
30	25	5	20	1,496
35	27	4	22	1,646

Applying the figures of the above table to a larger area, we find that a tract of sandy deposits one square mile in extent with an average depth of saturation of 50 feet and an available yield of 15 per cent. should afford about 1,564,000,000 gallons, or enough to supply a million gallons a day for 1,564 days, or nearly 4½ years.

Since, even in deserts, there are practically always more or less additions to the ground-water reservoirs thru replenishment from rainfall or percolation from temporary or permanent streams, the length of time the accumulated storage within the ground may be drawn upon by a water-works system will depend on the difference between such replenishment and the quantity withdrawn rather than on the absolute storage. Since this difference is often slight, at least as compared with the total volume of ground-water reserves, the probable life of a system under such conditions is often sufficient to warrant the installation of relatively expensive and permanent plants.

The following abstract from Mr. Burdick's paper adds some practical details which will make the view of the general subject more complete:

Cities Having Ground Water Supplies

At the present time about one-fourth of our cities exceeding 25,000 population are supplied with ground water and probably a somewhat greater proportion of the smaller cities and villages is supplied from this source. Altho great in number, but few supplies are large in the amount of water developed, Brooklyn leading with a 30,000,000 gallon development. Three or four plants produce 10,000,000 to 15,000,000 gallons daily upon the average; about a dozen pump from 5,000,000 to 10,000,000, and 40 to 50 produce 1,500,000 to 5,000,000 each. Altho no late statistics are available, no doubt the number of smaller towns and villages thus supplied is very large, for small supplies are cheaply developed over a large part of the United tSates.

With but few exceptions the large supplies have grown from small beginnings as the possibilities of the local situations have been demonstrated thru experience. In probably the great majority of cases the reasons for adequacy or inadequacy are but imperfectly understood, resulting often in disappointments in the yield from extensions and expenditures that could have been better directed with fuller knowledge of the general principles involved and the limitations of the local situation.

Most of the cities already supplied are growing rapidly, and many have approached that stage of development where additional wells do not seem adequately to meet requirements; where it seems wise to stop and consider whether further development along the lines of the past is wise, whether further expenditures will be permanently useful, or whether a radical change in the source of supply is not warranted in the light of probable future growth.

These sources being invisible are less easily comprehended than surface water supplies and more difficult of measurement, but with fundamental principles well in mind, coupled with a fair definition of the underground situation, meas-

urements and estimates become possible sufficiently accurate for practical development, and the labor of ascertaining the governing conditions in many cases is not difficult. It frequently consists in making the best use of facts already available in fragmentary form coupled up and supplemented by comprehensive tests and the intelligent consideration of records.

Effect of Development

Almost any practicable ground water development has the effect of changing the natural ground water conditions in that the surface of the ground water is depressed adjacent to the collecting system, thus producing a flow toward the collecting system not only along the path that the ground water formerly took, but also drawing in more or less ground water from all directions even from the downstream side to a greater or less extent, for ground water slopes are usually relatively flat, and the several feet of reduction in head at the collecting system are usually sufficient to produce a slope toward such system from all directions. The larger the draft of water and the deeper that the surface of the ground water is depressed, the larger the area thus influenced.

Most developments are made upon the lowest ground available for the reason that the ground water contours in general follow those of the ground surface, and by locating a collecting system upon the low ground, a larger gathering area is utillzed. The low places are also the usual location of the streams, and as these generally occupy their ancient channels there are here usually present the most porous materials, sand and gravel, if any are to be found in the locality. If the bed of the stream cuts into these porous materials as is frequently the case, an outlet for the ground water is formed in the state of nature and when a collecting system is inaugurated an important modification in the natural conditions occurs.

If the ground water in the collecting system is depressed below the surface of the stream, as is usually the case, the collection of the ground water in the vicinity is stimulated, and in addition there is a tendency to reverse the flow of ground water between land and stream, producing an inflow from the stream to the collecting system. There are some situations where this reversal of flow is not present; particularly where the stream flows upon a clay bed overlying the sand or gravel stratum from which the ground water supply is developed.

The rapidity with which the water may enter the ground from the stream obviously depends upon the available head, the coarseness of the material forming the stream bed, and it is also modified by the turbidity of the water and the relative duration of various turbidities; also the velocity of the stream as affecting the amount of deposits.

It is well known that a water filter constantly operated becomes choked and is necessarily cleaned if operations are continued. Precisely this situation exists in the stream beds and it is fortunate for the quality of the ground water that this is so, for it has a tendency to seal rapidly those places where for reasons of high porosity or steep gradient, the filtration rates are most rapid; thus in a way tending to distribute the seepage more uniformly over a larger area.

Altho the stream bottom may become comparatively impervious, such water tightness is comparatlve only, and the large areas subject to filtration adjacent to the ground water collection system produce considerable water even under adverse conditions.

Fundamentals of Yield

In any collecting system there must be:

1. A gathering ground sufficient to produce the required water; that is, an area sufficient in extent so that the absorbed rainfall made uniform by ground storage and supplemented by infiltration, if any, is sufficient at all times to meet the maximum draft of the collecting system.

2. That the location, character and depth of the impervious materials between the gathering ground and the collection system are such as to permit the passage of ground water at the rates demanded.

3. That the collecting system is so designed that the maximum rate of draft can be secured under the most unfavorable ground water levels that are likely to occur.

If any one of these three requisites is lacking, the supply must of necessity be measured by the weakest link in the chain.

In planning new developments or in materially increasing old ones, it is wise to select locations where present demands can be accommodated, and wherever possible, a large margin left for future demands, and it is further unwise to attempt to develop a gathering ground too closely to its estimated capacity. A factor of safety should be allowed in amount depending upon the accuracy with which the underground conditions are determined.

Available Supply

Experience seems to indicate that under reasonably favorable conditions, from one-quarter to one-half of the rainfall may be depended upon to replenish the

ground water. This experience is in well watered country, in localities favorable to ground water use. A local index is furnished by the low water flow of certain streams, particularly brooks or other water courses having a drainage area approximately coincident with that practicable for ground water development. In some situations the geological conditions may be uniform over a comparatively large area as in certain regions where the glacial work has been uniform. In such localities the minimum stream flow is a good index.

The following table indicates the approximate absorption capacity of several underground water sheds where capacity has been demonstrated by usage:

Relation Between Rainfall and Ground Water

Place.	Mean Annual Rainfall Inches.	Inches Ground Water Collected.	Ratio Ground Water to Rainfall.
Long Island	45	14 to 24	30% to 50%
Holland, Europe	26	8 to 13	30% to 50%
*Holland, Michigan	34	8.72	26%
Philadelphia, Pennsylvania	43	5 to 8	12% to 18%
*Jeffersonville, Indiana	45	3.6	8%

Note:
12 inches per year collected=570,000 gallons day per square mile.
8 inches per year collected=380,000 gallons day per square mile.
6 inches per year collected=285,000 gallons day per square mile.
* Watersheds observed not fully developed.

Transmission Capacity

In addition to a gathering ground and an ample collecting system, there must of necessity be present coarse materials of such nature and extent that water may travel from its source to place of collection. Sand and gravel is the only transmission medium of significance in municipal water supply. It has been demonstrated that the flow thru such materials departs from the law of flow thru pipes and follows more nearly that thru capillary tubes. The flow in sand and gravel at the velocities occurring in the ground varies with the first power of the head or slope. This law is evidenced by the practicable draft from the wells which increases in direct proportion to the amount that the water surface in the well is lowered thru pumping.

The capacity of a given material depends upon its porosity and to a large extent upon its coarseness, it having been demonstrated that the velocity of flow under a given head varies approximately as the square of the effective size of the grains in the material.

Thru the investigations, formulae and coefficients developed by Darcy, Krober, Hazen and Slichter, and particularly the application of these investigations to practical ground water problems as clearly outlined by Prof. F. E. Turneaure, it is practicable where the conditions are well defined and fairly uniform to approximate the capacity of the water transmission medium, and such computations are frequently of great use not only in ascertaining whether it is practicable to draw a stated quantity to a desired locality, but also in the design of the means for collecting the ground water.

The formula suggested by Professor Turneaure is a simplification of a formula of Hazen by the elimination of the temperature coefficient, as most ground waters have about the same temperature, and embodying all variables except slope in a coefficient which is varied to allow for the effective size of the sand and its porosity. The effect of porosity is based on investigations by Slichter.

The formula is quite simple, velocity in feet per day being equivalent to the product of the slope of the ground water hydraulic gradient and a coefficient, selected from tables, based on effective size and porosity. Knowing velocity and porosity, which represents the void space open to the travel of water, quantity can be computed from the dimensions of the water bearing stratum.

The important effect of "coarseness" is well illustrated by the following table prepared from Professor Turneaure's value for a porosity of 30 per cent.

0.10	Very fine sand	43
0.20	Fine sand	171
0.30	Medium sand	384
0.40	Coarse sand	681
0.50	Torpedo sand	1,066
1.00	Fine gravel	4,260
2.00	1/10 inch gravel	17,050
3.00	1/6 inch gravel	38,400

It should be noted that the effective size as stated refers to the smallest 10 per cent. of a given sample, according to the definition of Hazen; the small grains, tending to clog the interstices, having a governing effect.

The relation of flow to size in the above table indicates that under any given slope one foot of torpedo sand will transmit as much water as 25 feet of very fine sand, and 1 foot of fine gravel (size 1.0 m.m.) is approximately equivalent to 100 feet of very fine sand.

It is, therefore, the coarser materials only that are of much significance in a large water collecting system, and frequently the finer sands may be neglected or given nominal values without materially affecting the problem in hand.

Where the underground conditions are known as to depth and character of water bearing material, it is practicable to demonstrate the value of the flow coefficient by pumping a test well and observing the hydraulic gradient of the ground water. In several cases where the effective size of the water bearing material has been noted thru the sifting of numerous borings, the coefficients tabulated above have been approximated. If the purpose in hand requires an approach to accuracy, such tests of the water bearing materials in their original situation are necessary; and the coefficients thus developed eliminate inaccuracies in a number of other determinations in that the reasoning is then direct from quantity drawn to hydraulic gradient.

Knox Automobile Fire Apparatus

The widespread publicity gained from their first successful installations of motor fire apparatus in Springfield, Mass., described in a recent number of MUNICIPAL ENGINEERING, brought a large number of orders to the company, particularly from New England and adjoining states, with the results that this branch of the company's business was soon in a flourishing condition and has remained one of its most important assets ever since.

The Knox Co. is now manufacturing a very complete line of motor-driven fire apparatus, covering pumps of both piston and rotary types, combination and protective cars, hook and ladder trucks and tractors for hauling steam engines, hook and ladder trucks or other heavy kinds of apparatus.

This company has always believed in the policy of building fire apparatus of extra strong construction rather than using a touring car chassis slightly strengthened in vital parts, realizing that the strains to which this class of automobiles are subjected call for the utmost strength to maintain absolute reliability. deep channel steel frames and very robust axles, transmissions and steering gears.

A good illustration of the value of this type of construction is shown in the following experience which a Knox combination car passed thru in Coeur d'Alene, Idaho, a short time ago.

While on its way to a fire this machine skidded in turning a corner on wet All its models are therefore fitted with asphalt and was not stopped until it had cut off a telegraph pole 12 inches in diameter with the front bumper on the frame. It was able to continue on its way to the fire, however, and back to the engine house on its own power, being apparently none the worse for its encounter, with the exception of broken lamps, bent mud guards and a slightly dented radiator.

The standard type of combination car built by the Knox Co. is fitted with a 48-h.p. four-cylinder motor which has a large reserve power factor and is capable of driving these cars as high as 50 miles per hour, with full equipment. Single or double chemical tanks can be carried, and space is also provided for carrying 1,200 feet of 2½-inch water hose, as well as twelve men and full equipment of fire tools, etc.

The most promising model the Knox Co. has built is a new 600-gallon triple combination, pump, hose and and chemical car, fitted with a rotary pump and driven by a 60-h.p. six-cylinder motor of large reserve power. The pump on this machine is arranged with a special device for taking up wear on the blades, making it possible to keep it working on a high efficiency, even after continued service. One thousand feet of 2½-inch water hose can be carried on this car, together with ten men and equipment, making it virtually a complete fire department in itself. As this type of machine is much lighter than the piston type and can throw as high as 750 gallons of water per minute maximum, it has found favor with a great many towns and cities where good speed and hill-climbing ability, combined with moderate capacity, are required.

In the Knox-Martin tractor the company has a type of machine which is adaptable to a wide variety of purposes and one which is meeting with an extensive sale, as it can be applied readily to present horse-driven apparatus by merely connecting the rear springs of the tractor to the front axle of the apparatus and putting sprockets on the front wheels. Large size steam engines or hook and ladder trucks can be drawn with this machine at a speed of twenty-five miles per hour, and if used in connection with motor-driven hose cars can thus be brought to a fire in season to be used without loss of valuable time.

CIVIC BEAUTY

St. Louis Plans a Central Traffic Parkway

The St. Louis City Plan Commission, which came into existence two years ago, has made its report to the Municipal Assembly on the plan to establish a great central traffic parkway two miles in length, extending from Twelfth street to Grand avenue. This plan, carried out, would call for the acquisition of property lying between Market and Chestnut streets, a strip one block wide.

The City Plan Commission was created by ordinance and is composed of fifteen members. The duties of the body are as follows:

First. To prepare a comprehensive city plan for the future improvement, as well as for the commercial development of the city, including recommendations for:

(a) Improvement of the river front.
(b) Extension of streets and the supervision of the opening of sub-divisions.
(c) Improvement of surroundings of Union Station.
(d) A system of widening and opening various thru streets so as to make the city more cohesive and less disjointed.
(e) Control of nuisances.
(f) A playground, park and boulevard system.
(g) Location of public buildings.
(h) Encouraging the location of manufacturing establishments in designated districts.
(i) Extension of conduit district for wires.
(j) Extension of granitoid sidewalk districts, and for the regulation of same in the residence districts so as to provide for the planting of trees and for sufficient soil space to assure their growth.
(k) Such other improvements as will tend to make St. Louis a greater and more beautiful city.

Second. To suggest the state and municipal legislation necessary to carry out the recommendations of the commission.

Traffic Parkway

The commission's report to the Assembly says in part:

"This initial traffic parkway from Twelfth street to Jefferson avenue is the initial step in the planning for a greater and better St. Louis. If approved, it will be followed naturally by extension westward from Jefferson avenue to Grand avenue.

"The best city planning is that which permits traffic to pass from any point to any other point in a city by the most direct and expeditious routes. Judged by such definition, St. Louis today is not well planned. The traffic parkway from Twelfth street to Grand avenue will become a main artery of travel east and west. It will be supplemented by connecting radial thoronghfares which will make the city cohesive."

In discnssing the value of property in the vicinity of the proposed traffic parkway, the report states:

"In the vicinity of Olive and Twelfth streets (two blocks north of the eastern end of the proposed thorfare) values range from $1,000 a front foot upwards. About the intersection of Grand avenue and Olive street values have climbed to similar figures. Between these two centers of high priced and rising property lies a strip two miles long and half a mile wide. Three-fourths of the property embraced in that strip is not worth as much as it was twenty years ago. A considerable portion would not sell today for the prices realized thirty years ago; and some of it has dropped below the value of forty years ago. The depreciation in many blocks has carried this property downward to one-third and one-half of what it was considered worth by a former generation. Rentals have been reduced to fractions of what the improved property once yielded. Four-fifths of the buildings have been allowed to deteriorate. Hundreds of these buildings are now untenanted. A thousand of them yield the owners only nominal revenue.

"And yet this strip is the geographi-

cal center of St. Louis. Its gently undulating topography is ideal for the best city growth. This 'blighted district' fronts upon the main gateway into the city. Lengthwise thru it run the chief lines of travel between the business center and the residence sections.

"St. Louis has suffered severely from the shifting of values. The city has seen the leading commercial thoroughfares of one generation become the depreciated and half deserted avenues of another. The palatial homes of one generation have become the rooming houses of the next.

"St. Louis has ruins east of Fourth street and this long blighted district west of Twelfth street. City planning should aim to steady and make permanent the values of the business district. It should provide for logical commercial growth which will not be at the expense and loss of any other section. It should create great thorofares which will take care of future traffic without the congestion already apparent on downtown streets.

"Looking to such desirable development, the City Plan Commission recommends the acquisition of the blocks between Market and Chestnut streets westward from Twelfth street to Jefferson avenue, for the creation of the central traffic parkway. Present low values of realty encourage immediate action.

"The frontage on Twelfth street between Market and Chestnut streets, is assessed at $1,000 per front foot for the corner of Twelfth and Chestnut, and $1,100 per front foot for the corner of Twelfth and Market. The frontage on Twelfth street between the two corners is assessed at $650 per front foot.

"In the western part of the block, extending to Thirteenth street, the frontage on Chestnut street is assessed at $225, and on Market street at $400. These assessments hold for the two frontages except the corners at Thirteenth street, which are assessed at $350 for the Chestnut street corner and $500 for the Market street corner.

"On Grand avenue, the western terminus of the proposed traffic parkway, the ground between Lawton and Pine streets is assessed at $350 on Pine for the Grand avenue corner and $150 on Lawton for the Grand avenue corner. From both ends of the traffic parkway valuations diminish rapidly. East of Jefferson avenue the ground is assessed as low as $55 per front foot for Chestnut street frontage and as low as $65 per front foot for Chestnut street frontage and as low as $65 per front foot for Market street frontage. West of Jefferson avenue a considerable part of the frontage of Pine street is assessed as low as $35 per front foot, while the assessment of the ground fronting on Lawton avenue between Jefferson and Grand for several blocks runs as low as $30 per front foot.

"The valuations of improvements in the blocks within the limits of the proposed traffic parkway, show the same tendency downward. Between Twelfth street and Jefferson avenue, Market and Chestnut streets, there is only one block on which the improvements are rated by the assessor at over $100,000. That is the block between Eighteenth and Nineteenth, Market and Chestnut streets, opposite Union Station. The principal structures are hotels. The total valuation of the improvements of the entire block is $116,800. The improvements of the block between Sixteenth and Seventeenth, Market and Chestnut, are valued at only $41,800. The valuations of improvements on the other blocks range from $45,000 to $100,000.

"The total valuation of all the improvements in the twelve blocks from Twelfth street to Jefferson avenue, comprehended in the recommended plan for the traffic parkway, is $840,950, an average of only $70,000 to the block. For the entire 21 blocks between Twelfth street and Grand avenue the valuation of the improvements is placed by the assessor at only $1,656,050.

Five Plans for Development

"Five tentative plans before the commission illustrate the possible development of this traffic parkway. The blocks between Market and Chestnut streets are narrow from north to south as compared with other St. Louis city blocks. Lots fronting on these streets are only 81 feet deep in the block from Twelfth to Thirteenth street. West of Thirteenth street the lots are from 72 feet to 73 feet 5 inches in depth. This shallow condition prevails to Jefferson avenue.

"The condemnation of the blocks would give the city for the proposed traffic parkway a space of 287 feet width from the north side of Chestnut street to the south side of Market street. The tentative plans contemplate a division of this space into sidewalks, two traffic-ways, two spaces for street car tracks, two narrow parks and a central boulevard.

"The tentative plans differ chiefly in the proposed width of the sub-divisions. One of the plans gives the sidewalks along the property line of Chestnut and Market streets a width of 10 feet. Next to the sidewalk is allowed a space of 10 feet for grass and trees. The traffic-ways are 45 feet in width, this space including the two reservations for the car tracks, which are located along the south side of the Chestnut street traffic-way and along the north side of the Market street traffic-way. Next to the car track reservations are the strips of parking,

each having a width of about 55 feet. This width is divided to provide for a lawn of 30 feet, with two rows of trees, bordered by walks 12 feet wide. Between the two strips of parking is a boulevard 50 feet in width.

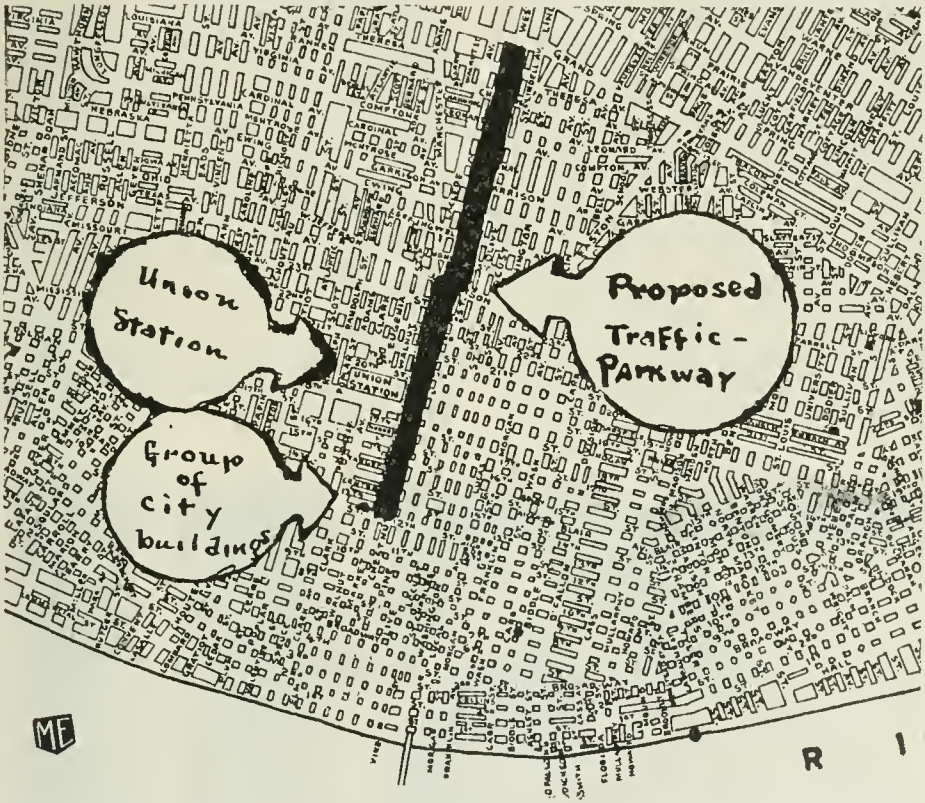
"The traffic-ways are for business and slow-moving vehicles. The boulevard is intended for fast-moving light vehicles. Along the street car reservations are walks bordering on the strips of lawn. This tentative plan is Proposition A.

"Proposition B varies from Proposition A in that it offers a different arrangement of the walks in the parking, so that one walk passes between and underneath the double row of trees. The space allowed between the rows of trees is 20 feet. The park width, including the walk beneath the trees is 53 feet 6 inches. The traffic-ways in Proposition B are 45 feet, the same as in Proposition A.

"Proposition C proposes to make the walks on the Chestnut and Market street frontages 16 feet wide and narrows the traffic-ways to 36 feet, placing the street car tracks within the parking in such manner that only the rails show above the grass. This plan would give for the parking, which includes the street car track space and the walk on either side of the double row of trees, a greater width than suggested in the other propositions.

"Proposition D also suggests the placing of the car tracks in the parking and covering all but the rails with grass. It allows 16 feet for the Chestnut and Market street walks, and gives the driveways a clear width without street car interference of 36 feet. It provides for two rows of trees in each strip of parking on either side of the boulevard, and for a row of trees between the sidewalks and the traffic-ways.

"Proposition E illustrates the possibilities of a subway underneath the traffic parkway at minimum cost for construction and with no damage to abutting property. The removal of the car tracks



TRAFFIC PARKWAY *location thru old and thickly settled portion of St. Louis will greatly increase value of property. Note central location in a congested but low value district between two higher class areas. A new method of improving a business district.*

and the substitution of a subway would allow, according to this proposition, a width of 66 feet 6 inches for each strip of parking including the sidewalks underneath the trees.

"In the central traffic parkway the night problem of downtown St. Louis will find a solution. The boulevard, 50 feet wide, two miles long, cleared for swift traffic, bordered by trees and grass, provided with seats, amply lighted after dark, will become the most frequented and most popular thoroughfare in all St. Louis.

"In Twelfth street today, St. Louis has a fire guard of inestimable value. No conflagration driven east or west could cross that plaza. In the central traffic parkway St. Louis would possess a like fire guard against flames driven by a north or south wind."

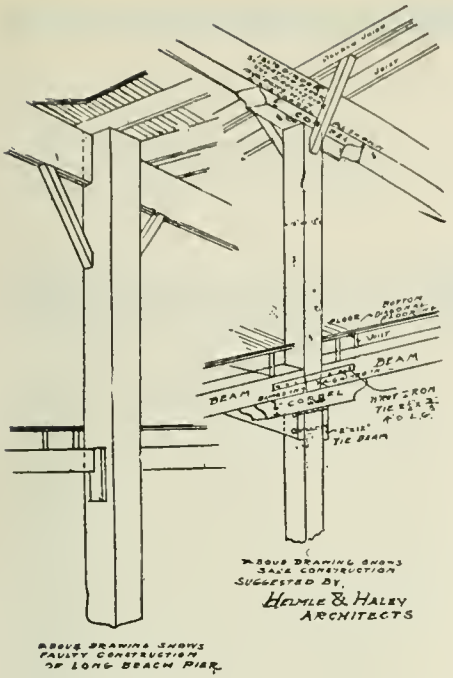
In closing the report, the commission discusses the need for new legislation. "The commission is strongly impressed with the conviction that the city authority in the matter of acquisition of property for park and boulevard purposes should be strengthened and should be more clearly expressed. The commission believes that in such acquisition the power should be conferred on the Municipal Assembly to give the property owner upon whom benefits are assessed the privilege of meeting such assessments in installments, distributed thru such series of years for each case as the assembly in its judgment may deem best.

"The commission urges such legislation as shall divide the cost of the proposed improvements between the adjacent property owners and the whole city on an equitable basis."

Municipal Auditorium Wreck at Long Beach, California

The collapse of the floor of the auditorium at Long Beach, California, resulted in the death of thirty-six persons and the injury of about two hundred. It occurred on May 24, Empire Day, which was celebrated by about 6,000 British subjects and others gathered at the beach. The great crowd was massed upon the upper floor of the Municipal Auditorium, where exercises were to be held, and the doors were foolishly kept closed, so that the weight of the participants was concentrated upon a very small area. The supports of a section of the floor gave way suddenly, dropping upon the lower floor, which in turn caved in, throwing the crowd pell mell upon the sand beneath the building. The structure was of frame construction and its use for large conventions was foolhardy, as the result shows. In addition to its danger of collapse, the building was always a fire menace, as a restaurant was conducted on the lower floor. By happy chance, the wreckage did not catch fire. The work of rescue began promptly and was carried out effectively by the Long Beach

MUNICIPAL AUDITORIUM WRECK *at Long Beach, Cal.*



How it was; how it should have been.

police, while the mayor of Los Angeles sent quick aid in a special train. Police, nurses and surgeons being hurried to the assistance.

The liability of the city will doubtless be tested in the courts and it is stated that damage suits for about a million dollars for deaths and injuries may result. The grand jury is now probing the causes of the disaster, and the general opinion is that the building was allowed to deteriorate from dry rot and the corroding effects of salt water. It is also claimed that the building was of too light construction and improperly built to hold the weight of the vast throngs which participated in frequent conventions, etc. The accompanying drawing compares the actual construction, as shown by the photograph, with a proper design. The structure will doubtless be torn down to make way for a modern, fireproof and solidly built auditorium.

Waste Heat Utilized by British Municipality

West Hartlepool, an important city on the English northeast coast, can claim to be the first municipal authority to produce electricity by means of waste heat from a manufacturing plant. It will open its new generating station in the course of two or three weeks.

The town since it first began to make its own electricity has relied upon a generating station of the ordinary type, with coal firing. The new station will possess twice the capacity of the old, and its two turbo-generaters, each of 1,500 kilowatts will be driven by exhaust steam from the furnace blowing engines of the Seaton Carew Iron Company, adjacent to whose works the station is built. In return for their exhaust steam, which has hitherto been blowing to waste in the air, the Seaton Carew Iron Company will receive free from the corporation's new generating station the supply of electric current that they need at their works.

When the new station is in operation the corperation will be able to produce electricity at a relatively cheap rate, for the expenditure on coal, which is the chief cost in generating current by the ordinary system, will practically be eliminated. The coal bill for the present electricity station is about $20,000 a year, and, as it is anticipated that the consumption of current will largely increase under the new conditions, the ultimate saving of coal by the use of waste heat will be very considerable.

The new turbines are so constructed as to be able to work either with exhaust steam or with high-pressure steam, and, in addition to the pipe which conveys the exhaust steam to them, a high-pressure steam pipe connects them with the Seaton Carew Iron Company's battery of boilers. Thus, should the supply of exhaust steam not be available, either thru a breakdown of the blowing engines or thru the iron works being idle, a supply of high-pressure steam will be obtainable and the output of current from the power station maintained.

The exhaust steam, after leaving the turbines will be condensed, and the water will pass thru a Lea Recorder back to the boilers of the ironworks. To supply the condensers with cold water three cooling towers have been erected, each capable of cooling 115,000 gallons of water per hour.

The total expenditure involved in connection with the new scheme is $193,975 the plant alone having cost $150,000. The old generating station will be maintained as a stand-by, and also as a town sub-station. The current from the new station will be conveyed to the sub-station by means of high-tension cables, and it will be transformed there to the voltage required for distribution to the town. Several large works will take their supply of electricity from the corporation, and the tramways, which are now the property of the town, will in due course be supplied with current from the town sub-station.

PERSONAL

Karl M. Mitchell, Business Manager, River Forest, Ill.

Karl M. Mitchell, who has been selected by the village of River Forest to act as its general manager, resides at 3827 Van Buren street. He was selected from a field of seventy applicants from twelve different states. Mr. Mitchell's appointment is for one year and appointment was made by John E. Adams, president

KARL M. MITCHELL, *business manager of River Forest, Ill.*

of the village, with the approval of the trustees.

"Out of the seventy applications received following the publicity given in the Chicago papers," said Mr. Adams, "there were about forty who appeared to be good men. I spent my mornings, evenings, and Sundays visiting all these that I could. I finally sifted down the most desirable applicants to four men. I told the board I would appoint the one that it approved. We had a little social gathering at which the four men and the trustees were present. A vote was taken afterward and Mr. Mitchell was selected. He appeared to have the best qualifications and the personality necessary for the position. All the members of the board of trustees are employed in Chicago and we felt that it was for the best interests of the village that we have a man always on the job in River Forest."

Mr. Mitchell is a graduate of the Chicago Manual Training school and is thirty-five years of age. He supplemented the theoretical and practical training received at the school by three year electrical course at the Y. M. C. A., one year in the railway organization at the University of Chicago, and three years in finance at Northwestern University, Evanston, Illinois.

Mr. Mitchell was connected with the Chicago Telephone Company for a period of sixteen years, the last five of which he served as division wire chief, chief installation superintendent and also as efficiency expert, doing considerable reorganization work and routine revision. During the past year he has been in business for himself.

River Forest is one of the most handsome residential suburbs in and about Chicago. In his new position Mr. Mitchell will have charge for the village board of all work save that pertaining to schools.

Personal Notes

Delos F. Wilcox, having resigned his office as a Public Service Commissioner for the First district of New York, has opened offices at 1008 Bennett building, 93 Nassau street, New York, for practice as a consulting franchise and public utility expert.

Edwin C. Powell, of Springfield, Mass., carries the idea of the Lincoln memorial highway still farther by laying out a series of five east and west highways, and

five north and south highways as national memorial highways. The names proposed are the Washington Lincoln highway from Boston to San Francisco, the Lewis-Clark and Northwest from Chicago to Tacoma, the National Road and Sante Fe Trail from Washington to San Diego, the Houston-Jefferson from St. Augustine to Phoenix, the Whitman-Alamo from Seattle to Galveston; the Greene-Bagley along the east coast, the Grant-Lee from Erie to Mobile, the Logan-Jackson from Chicago to New Orleans, the Meridian from Winnipeg to Galveston, and the Pacific boulevard along the west coast.

James C. Harding, consulting engineer, has opened an office at 170 Broadway, New York City. Mr. Harding has been engaged in the practice of hydraulic and sanitary engineering for the past twenty-one years and has been a member of the firm of George W. Fuller for the last two years.

Nathan C. Grover has been appointed chief hydraulic engineer of the water-resources branch of the U. S. Geological Survey, to succeed Marshall O. Leighton, who resigned to plan and supervise land drainage in Florida.

Frank W. Buffum, of Louisiana, has been appointed State Highway Commissioner of Missouri at a salary of $3,000 per annum.

Frank T. Townsend, Assoc. M. Am. Soc. C. E., recently Assistant Engineer, New York State Highway Department, has been appointed Assistant Engineer of the Inspection Department of the Dunn Wire-Cut-Lug Brick Co., Conneaut, Ohio. Mr. Townsend is a graduate of Rensselaer Polytechnic Institute, class of 1904, and has been with the New York State Highway Department for the past five years.

I. J. Crowley, E. A. Clark and James X. Gunning, of Chicago, are the Engineering Construction Company, Inc., designing and constructing civil engineering works of various kinds with offices at 106 North La Salle street.

E. Holland has been appointed city engineer at Guelph, Ont.

Louis D. Kelsey has been appointed city engineer of Aberdeen, Wash.

Louis Wyman, of Silverton, Colo., has been appointed state road inspector of Colorado.

Charles B. Buerger has joined the staff of Mr. George W. Fuller, 170 Broadway, New York City. Mr. Buerger entered the service of the Bureau of Filtration at Philadelphia in 1906 as a mechanical engineer and was engaged upon the design, construction, and testing of pumping stations and equipment. Later he was on the design of the preliminary filters at Torresdale and Belmont and had charge of the design of the Queen Lane filter plant. For the past two years he was senior assistant engineer in the filtration division of the Department of Water Supply in New York City on the design of the Jerome Park filter plant.

Walter W. Curtis, M. Am. Soc. C. E., Consulting Engineer, Chicago, Ill., has discontinued his Chicago office to take charge as president of the Curtis Coal Mining Co., Colorado Springs, Colo. He will continue, however, to devote a portion of his time to private engineering practice, with headquarters at 1015 North Nevada avenue, Colorado Springs.

Edwin Thacher and William Mueser have dissolved the partnership of the Concrete-Steel Engineering Co., 21 Park Row, New York City. Mr. Mueser will continue the business under the former copartnership name, and Mr. Thacher will engage in private practice as a consulting engineer with offices in the same building.

C. G. Elliott, M. Am. Soc. C. E., has resigned as Chief of Drainage Investigations, United States Department of Agriculture, and will devote his time to private practice, with offices in the McLachlen Bldg., 10th and G Sts., Washington, D. C.

Arthur H. Blanchard, M. Am. Soc. C. E., professor of Highway Engineering in Columbia University, sailed on June 12th to attend the Third International Road Congress, London. Professor Blanchard is a United States Reporter on Question 3, "Construction of Macadamized Roads Bound with Tarry, Bituminous or Asphaltic Materials," and Communication 10, "Terminology Adopted or to be Adopted in Each Country Relating to Road Construction and Maintenance." He has been appointed a delegate to the Congress by Columbia University, the American Society of Civil Engineers, the National Highways Association and the American Road Builders' Association.

R. J. W. Worcester is superintendent of roads and bridges for the town of Concord, Mass.

Technical Associations

The Colorado Association of Members of the American Society of Civil Engineers has elected G. N. Houston, president; A. O. Ridgeway, vice-president, and R. W. Toll, 700 Tramway building, Denver, secretary-treasurer.

The convention of the Nebraska Cement Users' Association and the Mid-West cement show will be held in Omaha, Neb., between January 30 and February 4, 1914.

The municipal convention of the American Water Works Association is in session as this number of MUNICIPAL ENGINEERING is on the press. Abstracts of some of the interesting papers presented will be found in this and subsequent numbers. The early interest in the convention insured its success.

The third American Road Congress un-

der the auspices of the American Highway Association, the American Automobile Association and the National Association of Road Machinery and Material Manufacturers, will be held at Detroit, the week of September 29, 1913. The meeting of the Michigan State Good Roads Association with 15,000 members and the Ontario Good Roads Association will be held in conjunction with the Congress. An exhibition of road building methods, machinery, materials and results will be held. Logan Waller Page, Director of the U. S. office of Public Roads, is president, and J. E. Pennybacker, Colorado building, Washington, D. C., is secretary.

A large American delegation attended the International Road Congress held in London, Eng., June 23 to 28. About twenty-five of the papers presented are by American authors.

The American Road Builders' Association will hold its annual convention, congress and exhibition at Philadelphia, December 9 to 12, 1913. Samuel Hill is president and E. L. Powers is secretary.

The seventh Chicago cement show will be held in the Coliseum February 12 to 21, 1914. First allotment of space will be made to exhibitors on July 29. In addition to the cement users' association meetings there will be a national conference on concrete road building.

The Anglo-American exposition will be held in London, England, May to October, 1914, to celebrate the centenary of peace and progress in the arts, sciences and industries of the United States of America and the British Empire.

In connection with the Panama Pacific International exposition to be held in San Francisco in 1915 an International Engineering Congress will be held under the auspices of five national engineering societies, the American Societies of Civil and of Mechanical Engineers, the American Institutes of Mining and of Electrical Engineers and the Society of Naval Architects and Marine Engineers. Representatives of these societies are members of the committee on participation and local engineers have been appointed to the various organization committees by W. F. Durand, chairman of the executive committee. W. A. Cattell is secretary and treasurer of the executive committee, with offices in the Foxcroft building, 68 Post street, San Francisco, Cal.

Technical Schools

The April bulletin of the University of Michigan is devoted to the department of engineering, and contains a general announcement of courses in engineering and architecture for 1914 and a full biographical register of the alumni of the engineering department from 1860 to 1912.

The University of Michigan is preparing to establish a bureau for the study of modern municipal problems and collection of material to place at the service of Michigan municipalities. The training of experts to become administrators and specialists in city department work will be a part of the function of the new department.

Harvard University and the Massachusetts Technical Institute have established a new course of study of two years to prepare students for sanitary work. It will be operated by a committee of which Dr. M. J. Rosenau of Harvard Medical School, and Prof. G. C. Whipple, of Harvard University, are members, and Dr. W. T. Sedgwick, of Massachusetts Institute, is chairman. The course will not interfere with the present four-year course in the Institute nor with the two-year course for graduates of medical colleges now offered by the University.

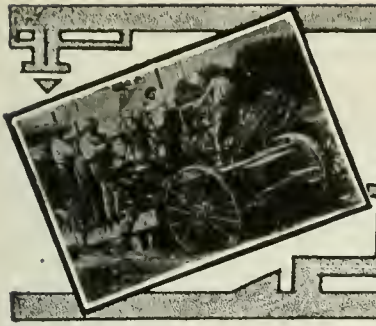
"The Steam Consumption of Locomotive Engines from the Indicator Diagrams," by J. Paul Clayton, has been issued as Bulletin No. 65 of the Engineering Experiment Station of the University of Illinois, which develops and illustrates the application of the logarithmic diagram to locomotive engines. It is shown that the steam consumption of locomotive engines can be determined from the indicator diagrams alone to within 4 per cent. of the actual consumption as measured in test plants.

"The Properties of Saturated and Superheated Ammonia Vapor," by Professor G. A. Goodenough and Mr. W. E. Mosher, has been issued as Bulletin No. 66 of the Engineering Experiment Station of the University of Illinois. It contains two tables of the properties of saturated ammonia and an extensive table of the properties of superheated ammonia. The essential results are embodied in a convenient chart by means of which the usual practical problems of refrigeration may be solved graphically with a minimum of labor and with a satisfactory degree of accuracy.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places as follows:

July 16, 17: Hull draftsman with experience in dredge design in office of Chief of Engineers, U. S. Army, at $1,800 a year.



MACHINERY AND SUPPLIES

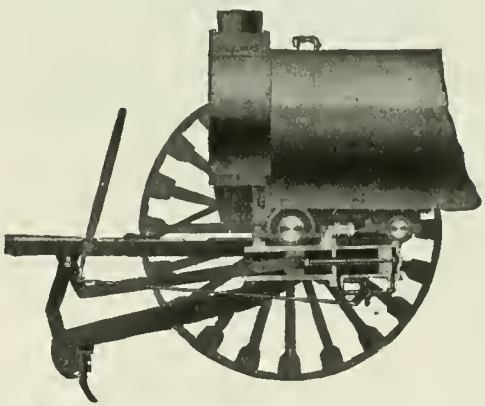
A Roller and Scarifier Combined

"A score of years ago road building was a very simple business," states F. E. Ellis, manager, Essex Trap Rock & Construction Co., Peabody, Mass. "The road contractor then required but little equipment. During the last ten years, however, methods of road building have changed and contractors now face the problem of choosing among multitudinous types and makes of machines for every imaginable purpose.

"Road building has become a business into which one should not enter without considering thoroly the kind and amount of equipment required to do the work that he is contemplating, and only after a careful estimate has been made of the expense of plant and the proportionate charges that should be made for the same upon the work on which he is bidding. One must also reallze that once in the business, he must remain in it for many years in order to get back the cost of his equipment, or else be willing to take a loss on the sale of it upon retiring. In other words, it is not a business that a man should enter upon with the idea of it being temporary, but with the idea of permanence. Failure to understand or obey this principle has been disastrous to many contractors. If the proper plant charges are not made, the contractor is deceiving himself just as surely as did the kind old lady who gave gingerbread to all the children in the neighborhood, and thought it did not cost anything because she had everything in the house to make it of.

"The choosing of that equipment which will not only do the greatest amount of work per day but also the greatest variety of work is a most important factor in the business. Contractors now realize that a steam roller which will do all the rolling any roller can do but which also has sufficient power to haul wagon trains and run stationary machinery is greatly to be preferred, as it cuts out necessity of tying up capital in mere hauling engines which can only be used for hauling purposes.

"The Huber road roller and scarifier combined not only takes the place of two machines but can be used as a hauling engine, also as a power plant for the running of stationary machinery. The economical advantages of this type of machine will appeal to contractors making a specialty of road construction. The scarifier is a part of the roller itself. It consists of nine large and heavy



COMBINED ROLLER AND SCARIFIER
showing operating cylinder.

spikes carried in a heavy steel bar which is as long as the extreme width of the roller. This bar is connected with the rear axle and thus all the pulling strain comes on the axle of the roller. The lowering of the spikes into the road is done by means of steam pressure and these spikes are held in place by this same pressure, the depth being regulated by gages at the sides. There is sufficient cushion to the compression so that when solid rock is encountered it gives enough to allow the spikes to slide over the obstruction. These spikes, however, are immediately forced down by the same steam pressure immediately after sliding over the obstruction. The scarifier can be raised or lowered instantly by means of a straight lever, which is placed close to the operator's seat. The

power for the operation of this scarifier is provided for by a simple and independent cylinder placed immediately beneath the boiler. When not scarifying the attachment is carried clear of the ground and does not in any way interfere with the operation of the roller when used for rolling, hauling or stationary plants.

"The grader may be hitched behind roller when scarifying and the surface put in excellent shape for the roller; then the scarifier is raised, the grader removed, and the road rolled and put in as good a shape or better shape than when new.

"One of the special advantages of this combination machine rests in the fact that steam is generated in a boiler of exceedingly large capacity thus having an abundance of power for purposes above mentioned. The rear rolls or drivers give an exceedingly large rolling surface and a strong grip on the ground. These rollers are beveled on the inner edges so as to give proper crown to the finished road. Adjustable scrapers fit closely to both the front and rear of each roll so that no matter whether the engine is traveling backward or forward the surface of the rolls is always kept in a cleanly condition. These combination machines which are furnished by The Huber Mfg. Co., of Marion, Ohio, have a master gear in each rear roller. The Huber also has a spur gear differential, well protected from dust and dirt, thus permitting the transmission of power to each driver at all times and permitting the turning of curves without slipping or side draft."

Use of Steel Curb and Gutter Forms

"Steel curb and gutter forms are rapidly taking the place of wooden forms in curb and gutter construction," state Zittrell & Sullivan, Webster City, Iowa. "They not only lower the cost of construction, but secure absolute uniformity of work.

"We use Heltzel system steel forms, as manufactured by the W. B. Jones Boiler Co., Streator, Ill., having purchased 250 linear feet last season and on June 12 placed an order for 250 feet more with curved corner forms complete; evidence that they are satisfactory. These forms are composed of plates or templates. Rigid side rails are made of annealed steel, pressed to shape in sections of 12-foot lengths, with curvilinear openings in the top flange to receive the division plates at intervals of six feet. These rails are 4, 6, 8 and 12 inches deep with a 2-inch flange on the bottom and a 3-inch flange on top, from which is a depending flange of one inch, and are connected end to end by a sleeve.

"Rigid adjustable side rails 5 feet long are arranged to telescope a part of their full length with the regular side rails. Flexible side rails made in 6, 8, 10 and 12-foot lengths, slotted at intervals of one foot for division plates, are for use in curved sections.

"Division plates ⅛-inch thick and to section length, have tapering slots at their ends to make the forms easy to set up and take down. Directly under each slot in the side rails is stamped a protuberance which serves to engage the division plate firmly with the side rail when placed in position. This device permits the template to be removed without disturbing the side rails.

"Our forms permit of exceedingly rapid removal and resetting and perfect alinement is easily secured. We always have a free top surface to rod off even. The template is removed without disturbing the side rail and it is an easy matter to set up a hundred feet of curb and gutter forms from a hundred feet of sidewalk forms. The rigid rails come in lengths of 6, 9 and 12 ft., whereas the flexible side rails, which telescope the regular rails, are 5 ft. in length and are adjustable from 5 ft. upwards. The curves come in 18-inch radius to fit rails. The Standard curb and gutter forms which we use are 24 by 12 by 6 inches and have 3-inch flanges.

"In the street crossing forms the same side rails are used as those in sidewalk forms and in making up street crossing forms all that is necessary is 6 or 8 division plates. By the use of two telescope rails 6 ft. in length it is an easy matter to set these forms to any width of scope rails 6 ft. in length is an easy matter to set these forms to any width of street. These forms can also be very efficiently used in double rails of blocks and we many times set up forms for an 8-ft. drive with 4-ft. division plates. This type of form particularly appeals to us in view of the fact that the division plates may be removed without disturbing the side rails, also that the self-locking principle of division plates requires no wedges or keys.

"The division plates may be removed by one man without use of hammer and without disturbing the side rails. They are perfectly smooth and have no connecting togle or pit. The side rails are made adjustable so it is a simple matter to set the forms at any odd place without using wood to fill in. Three hundred feet of forms set the base for a big mixer and gang of 20 men and one form setter. With 100 ft. of form it is possible to lay 350 ft. of walk per day."

29th Street, Norwood, Birmingham, Ala. Road Built with "TARVIA X."

The Modern Road Binder

PLAIN macadam roads are adapted to slow horse-drawn traffic. Modern traffic, with its high speed, disintegrates and destroys the ordinary macadam. Its mineral binder cannot resist the thrusts of a driving wheel.

Roads adequate for modern traffic must be bonded with something adhesive, ductile and resisting. Such a binder is Tarvia, a specially prepared coal tar compound which retains its good qualities through all weathers and seasons and holds the stone firmly in place, resisting all classes of modern traffic.

Tarvia is made in three grades:—"Tarvia X" is a very dense material to use as a binder in the large voids of new construction; "Tarvia A" is of thinner consistency for surfacing operations; "Tarvia B" is used cold, can be applied from a sprinkling cart and is sufficiently limpid to percolate into the pores of an old and well compacted road.

"Tarvia X" is required where new construction is called for. "Tarvia A" and "Tarvia B" are used in improving and protecting roads already in use.

A tarviated road or pavement is practically dustless and mudless, and the maintenance cost is, in most cases, so reduced as to more than save the cost of Tarvia treatment.

Booklets on Request.

BARRETT MANUFACTURING COMPANY

New York Chicago Philadelphia Bostoo St. Louis Kansaa City Cleveland
Cincionati Minneapolis Pittsburgh Seattle Corey, Ala.

The Paterson Mfg. Co., Ltd.—Montreal, Toronto, Winnipeg, Vancouver. St. John, Halifax, Sydney, N. S.

A "Bubble Font" That Is Safe and Saving

The widespread interest being taken in the bubble fountains since the passage of the laws in various states abolishing the public drinking cup, has led to the invention of a number of devices intended to supplant the public drinking cup or rather the public fountain.

Among the numerous fountains that have been brought to the public attention, is one which is anti-freezing, self-closing and absolutely sanitary. This is known as the Murdock "Bubble-Font," and its invention came about in a peculiar way.

"Two summers ago," said the inventor, Mr. Murdock, "I was returning from a few weeks' vacation in northern Michigan. There were quite a number at the railroad station waiting for the train. It was a hot sultry day, and every one of us was simply dead for a drink, and altho

THE MURDOCK "BUBBLE-FONT."

there was a water cooler at the station there was not a single drinking cup in the crowd. Right then and there I determined to invent a public drinking fountain that would be absolutely sanitary, that would be anti-freezing, self-closing and self-draining, and I know that in the Murdock 'Bubble-Font' I have such a device."

Mr. Murdock then showed the writer one of their new Bubble-Fonts which he had installed on the street in front of their establishment at 426-430 Plum street. A few moments spent in noting the ease with which the men, women and children could quench their thirst substantiated all the claims made by the inventor.

In the accompanying illustration is shown an outlined design of this new "Bubble-Font," and the readers' attention is called to some of the following distinctive features. First, this font is anti-freezing, because the valve that operates the inflow of water is located in the ground below the frost line, and the overflow and waste are both conducted into the sewer below the frost line. Second, it is self-closing. The bubble of fresh clear water is formed by pressing the foot pedal, which is located just above the ground, as is shown in the illustration, and as soon as the foot is removed, a strong spring instantly closes the valve. The treadle can be forced down only so far, throwing a stream of water from one inch to an inch and a half high, maintaining a steady flow which does not splash the individual.

Third, this is non-pollutable, as the lips touch only the flowing water. The Murdock font is in no sense a bubbling cup, as there is no cup about it. When the valve is open, the bubble washes all exposed brass parts, so that ink or any liquid maliciously poured into it would flow thru either the bubbling device or the waste into the sewer.

A study of the construction of the bubbler would show that even where ignorance causes a diseased mouth to touch the metal, persons following would not be liable to contagion, because the water flows thru not only the lower aperture, avoiding contact with any exposed surface before expanding into the bubble, but it also washes back over all exposed surfaces, thoroly cleaning them.

It is sanitary because the integral trap at the bottom prevents sewer gases from arising to the drinking point. The Murdock Bubble-Font is made by the Murdock Mfg. and Supply Co., of Cincinnati, and is especially adapted for schools, railway stations, factory yards, parks, and city streets.

Blue Printing Machinery

As Used by the Multi-Color Copying Company, Detroit, Michigan.

"Our experience with the blue printing machinery has been quite extensive, as we are in the commercial blue-printing

Port Huron Hand Steering Reversible Dump Cars can be pulled in train and—**can be backed in train. Can you back a train of your cars** 2 feet? 2 rods? 2 miles? with only two men?

Can be used where any other cars may be—**and** in **many** places where **others cannot.**

Port Huron
ASK THE USER

The New York-Port Huron "Standard" Road Rollers—2 sizes.

Port Huron General Purpose Road Rollers—4 sizes.

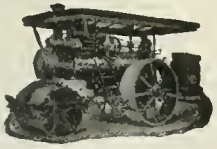
Port Huron Hauling Engines.

The Port Huron All-Steel Hand-Steering, Reversible, Stone Spreading and Dump Cars.

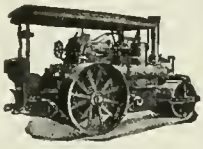
Port Huron All-Steel Stone Spreading and Dump Cars.

New York-Port Huron Scarifiers.

Port Huron Road Making Machinery.



Port Huron
ASK THE USER



THE PORT HURON LINE

OF HEAVY POWER ROAD BUILDING MACHINERY IS

The Most Complete in the World

STANDARD

New York - Port Huron Rollers

The ARISTOCRATS

OF THE

Road Roller World

Booklet No. 10 will be gladly mailed you on request.

Port Huron Engine & Thresher Co.

PORT HURON, MICHIGAN.

REPRESENTATIVES IN ALL PRINCIPAL CITIES.

business, and we are pleased to give you our experience, considering that it may be of value to municipal engineers now considering the advisability of installing machines in their drafting rooms.

"We have been in the commercial blueprint business almost since its inception and know the different types of machines used, as well as the different systems; also the manufacture of blueprint paper, quite thoroly. At present our plant comprises about 5,000 square feet in the business center of the city of Detroit, and our machinery has been selected only after a thoro comparison and study of all existing makes, in so far as efficiency and service, as well as reliability, are concerned, which are the main features in the successful blueprint establishment.

"We were the first people in Detroit to use electric blueprint machines. That was about ten years ago, and our equipment consisted of one blueprint machine. This machine sufficed for our needs for about three years; then the demand for blueprints increased and our needs were not taken care of by even two of these machines. At that time the first continuous blueprint machines made their appearance, and we tried different makes both of mercury vapor type and arc lamp construction, going even so far as to construct a machine after our own ideas, which did the work well enough but was not as well as a machine which in the meantime, came out, and of which we are at the present time using three in our plant. We refer to the Pease peerless automatic continuous blueprinting, washing, developing and drying machine. This machine is built on the idea of a newspaper printing press, feeding in the tracings on top of a continuous roll of blueprint paper on one end, and developing and drying the exposed prints at the other end of the machine, so that they come out perfectly dried, hardly stretched out of shape, loosly rolled ready for trimming, while the tracings are returned immediately direct to the operator, making it possible to make many copies of the same tracing as easily as making only one at a time. The speed control is positive by an electric rheostat with 60 different speeds, besides a high and low-gear shifting device, and different shades, increasing and decreasing the printing surface of the machine. The speeds range from six linear feet a minute down to as low as a quarter of a foot per minute, giving the operator a chance to control the work absolutely, and while running, change his speed from the very fastest down to the slowest speed required for special positive blueprints, prints, printing from bristol board, etc. We believe that this type of machine is by far the best where there is a daily consumption of more than say 100 yards of blueprint paper, and we believe that its price can be saved within six months after installation.

"We have lately tried girls to operate these machines and have found this a very satisfactory method, particularly as they handle tracings with greater care and are more adept in trimming prints. The cost of operation resolves itself practically to nothing but the amount of current consumed and the cost of the new carbons used, as the machine is built so simply and rigidly that so far there have been no repairs to speak of, altho the first machine has been running now for over two years. Our daily output varies considerably, anywhere between 500 and 1,500 yards of blueprint paper.

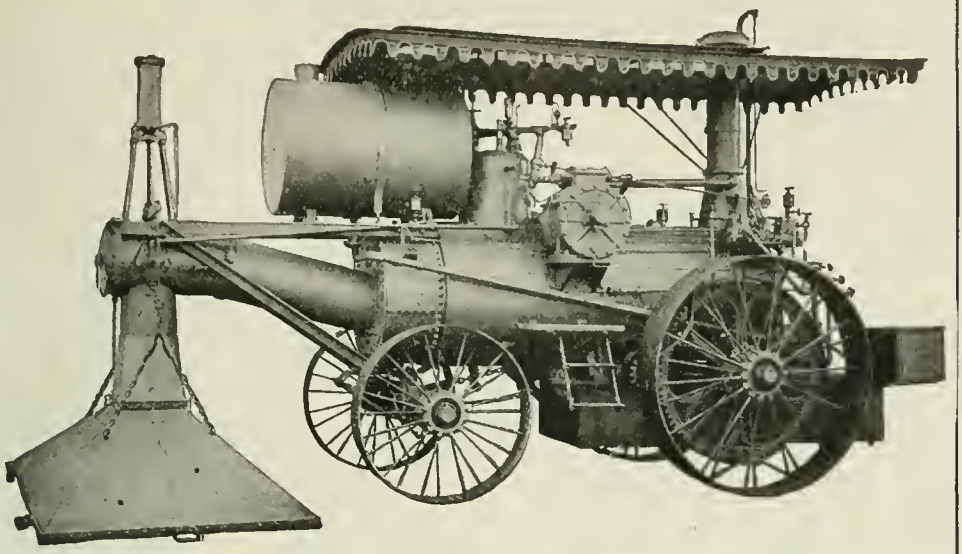
"The celerity of this output is greatly increased by the use of ingenious electric trimming tables as well as hand cutters which we use extensively and which are also operated by girls. Thus we are able to do the work more quickly and much better than we used to by means of scissors. Another great improvement which we are just installing, is the new Pease positive blueline attachment which furnishes us with positive blueline prints made direct from the tracings at the same speed as ordinary blueprints with practically no more care. This class of work is particularly adaptable for map work or where there are changes required later on, as for instance, the addition of plumbing, heating, ventilating, etc., in a building, or any other change in the mechanical drawings, also for forms where only a limited number of prints are required. On account of its simplicity, we find that there is a great demand for this special process.

Staley Tamper Attachments

The Lourie Manufacturing Co., Springfield, Ill., makers of the Staley power tamping machine for the tamping of the back filling in trenches have added several attachments to the machine as will be noted in accompanying photograph.

One of the attachments consists of a diaphragm pump with suction hose for pumping water from trenches. This type of pump is now being furnished for use on those machines sold previous to this late invention, and the Lourie Manufacturing Co. reports that it is in a position to furnish the crank wheel attachment with pitman for connecting pump to the gearing of the tamper.

The spiked head for tamping bar is also furnished for breaking concrete base. Different shaped heads for the tamping bar can be used, such as the



THE LUTZ SURFACE HEATER

——gently heats and softens (without flame) old pavements to same consistency as new material. The temperature of both materials being at the vulcanizing point, when tamped, smoothed and rolled a perfect weld is produced, leaving a finished surface. Instead of having a "patch" the repair becomes a part of the whole.

H. H. SCHMIDT,
(Chief Engineer Borough of Brooklyn, City of New York)
STATES:

"We operate four Lutz Surface Heaters—the resurfacing of asphalt pavements which, through age and wear and tear are beyond ordinary repair, can be most economically done with these machines."

THERE IS ONLY ONE WAY

of repairing, resurfacing and maintaining asphalt and other bituminous pavements, and of cementing asphaltic and other bituminous mixtures on granite, brick, cobble or hard pavements, and that is by means of **The Lutz Surface Heater.**

Illustrated Particulars on Request

Equitable Asphalt Maintenance Co.

Commerce Building. **KANSAS CITY, MO.**

round disc head as shown in the photograph.

The lifting mechanism is very similar to the well known board drop-hammer used for years in drop-forge shops. The mechanism as applied to the power tamping machine is even more simple than the drop-hammer. This lifting mechanism consists of two parallel rolls mounted on shafts running to bearings bolted to the sweeps; the rolls are geared together by spur gears, and are driven by a pinion engaging the gear on the rear roll; the driving shaft runs in bearing bolted to the sweep. The rolls and shaft are kept in line and adjustment by steel tie-rods which pass thru all the bearings and have nuts and lock nuts on each side of each bearing. The front lifting roll is pressed against the lifting board by coiled springs on the tie-rods passing thru the bearings, and are adjustable by nuts and washers. The length of stroke as well as the gripping and releasing of the lifting board is automatically regulated by cutting away a part of the circumference of the lifting rolls, thus the board is automatically gripped, raised and released, once for each revolution of the lifting rolls. The lifting board is of hardwood reinforced with a small steel channel on the edges; the lifting board slides in long steel channel guides riveted to the sweep channels with a heavy gusset-plate, and braced from the top back to the sweep. Mounted in the gusset-plates just above the lifting rods, is a pair of grips or dogs which are connected by a short lever and bell crank; these grips are normally pressed against the lifting board by a coil spring acting on the bell crank, but when the lifting board is in motion the grips are held out of contact with it by a small rod and latch placed near the left hand of the operator. When it is desired to stop the motion of the tamper, the latch is replaced and the grips prevent the board falling, but allow the lifting rolls to raise it the length of the stroke at each revolution; while the board is prevented from rising above a fixed point by reducing the thickness of the board near the lower end. When the reduced section raises to the center of the rolls, they do not grip the board and it thus remains in this position until it is released by the operator.

The Seagrave Pump

By B. K. Black, The Seagrave Company, Columbus, Ohio.

The Seagrave pump is different from the ordinary pump now generally used on fire apparatus. It is neither of the rotary gear nor piston type, but is a multi-stage centrifugal turbine, built along the general lines of the turbine pump, which is rapidly replacing the positive displacement pumps in steam ships, city pumping plants, boiler feed pumps and those used in mines, except that it is more refined and built particularly for fire department work. It is more compact, much lighter in weight and capable of delivering large quantities of water at high pressures.

Our pumps are made in two sizes both of which are entirely of bronze. The 750-gallon size is two-stage; 1,000-gallon size, three-stage. By referring to the line drawing it can be seen that no valves of any kind are required in its operation, not even a relief valve. The water as it comes from the hydrant or cistern enters the intake pipe and then passes into the center of the first stage or impeller around the impeller shaft. This impeller impresses on the water a certain pressure and with this pressure it follows the guides or diffusion vanes which deliver it to the center of the second stage or impeller, which adds more pressure and so on thru all stages of the pump. The pressure given the water by each impeller depends on the speed at which the pump shaft is rotating. It will be noticed that the water travels in a spiral course, all in one direction, and at no time is it forced in an opposite course, as in the piston type of pump; also that the impellers have no reciprocating action, thus obviating all vibration.

All waterways are finished smooth, thereby reducing friction and increasing efficiency. No moving part of the pump touches any other part except where the impeller shaft rests in its bearings at each end, and as these are ball bearings, wear and friction are reduced to a minimum. This is a very important feature because it means that the pump will practically never wear out. And as it cannot be found in any type of rotary gear or piston pump, should be worthy of your careful consideration. The pump is geared up instead of down, as are other makes, thus permitting the use of a slow-speed, long-stroke motor (7¾ by 9 inches), which is the only method by which a dependable motor-pump engine can be successfully operated for long periods without shutting down. The motor delivers its maximum h. p. at 750 r. p. m., and the pump makes 1,500 r. p. m. Compare this engine speed with 1,500 to 2,000 r. p. m. of other makes.

An important feature of this pump is the elimination of relief valves of every kind. Owing to this construction should all lines of hose or gate valves at the pump be shut off at once the pump merely churns the water it contains and the motor accelerates, thus eliminating en-

BAKER ARMORED

CONCRETE PAVEMENT

1,249,678 Square Yards Now in Use in Fifty Cities

Wayne County, "The Mother of Concrete Roads," uses Baker Armor Plates exclusively.

THE BAKER SYSTEM OF INSTALLATION

enables the contractor to install steel protected joints in perfect alignment, and to correct grade.

ALL NECESSARY APPARATUS

is furnished with each shipment of armor plates free of charge.

We guarantee Baker Armor Plates to be perfectly crowned as specified, and entirely free from any defects of manufacture.

SPECIFICATIONS FOR BAKER ARMORED CONCRETE PAVEMENT SENT FREE ON REQUEST

THE R. D. BAKER CO.

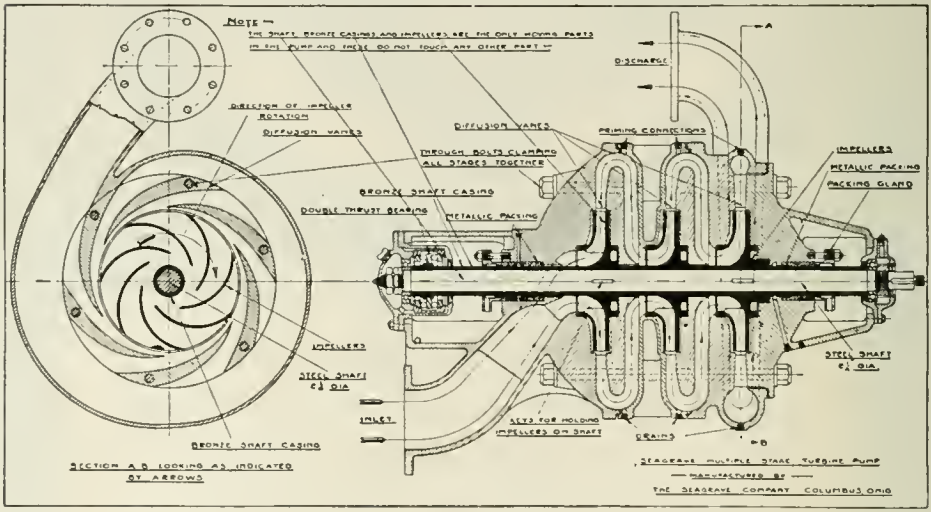
73 Home Bank Bldg. DETROIT, MICH.

tirely all danger of stalling the motor. With all lines shut off and the motor running wide open a pump pressure of 350 pounds is developed, thus outclassing the steam fire engine.

All Seagrave pumping engines are equipped with our automatic regulating device (another important feature not found on any other make of pump), which is operated by the pump pressure and automatically controls the throttle valve on the carburetor so that in case three lines of hose (of any length) are in use and a pressure of 80 pounds is being maintained on all three nozzles, if one nozzle is shut off, the motor is thereby automatically throttled so that only 80 pounds is maintained on the other two lines. The same condition follows should another line be shut off.

A very important feature of the Seagrave pump (and one not found in any other type), is its ability to pump water containing solid matter, such as sand or even rocks whose largest diameter does not exceed ¾ inch without the slightest injury to the pump. Of course, it is not built for gravel-dredging purposes, but will handle such of these as are sometimes encountered in fire department work. This is a decided advantage in cities where drafting from lakes, rivers or cisterns is necessary or where muddy water is to be handled.

As stated above, the multi-stage centrifugal pump is rapidly replacing other types in all lines of work where pumping equipment is required and it is destined to replace the rotary gear and piston type of pump in fire department work; therefore, we ask you to investigate fully the Seagrave pumping engine. Incidentally watch our competitors follow our lead and try to copy this pump, but remember we have the machine perfected; you are taking no chance and the entire outfit is built of Seagrave high quality workmanship and material backed by Seagrave's strong guarantee.



SECTIONAL VIEW OF SEAGRAVE *Multiple Stage Pump.*

The Standard Traction Paving Mixer

By L. A. DeVore.

The Standard Scale & Supply Company are marketing a new type of mixer, specially designed for street paving work and which is known as the Standard traction paving mixer.

This new mixer is furnished with three carts, each cart holding the full capacity of one complete batch. The carts are loaded at the material piles by the shovelers. One man operates the mixer and one man guides the carts. A cable attached to the hoisting drum on the mixer, operated by its own power, draws the carts up the incline and automatically dumps the entire batch. The guider then guides the cart back and hooks the cable to cart number two and goes thru the same operation.

Many contractors who now have this type of machine in operation state that they are able to turn out 1,500 square yards of 4-inch base with less men than heretofore. One contractor states that he has been enabled to eliminate six men thus making a saving from $12.00 to $15.00 a day. "The Standard" sectional distributing trough is made so that every 2 feet may be folded up and

THE HUBER ROAD ROLLER

AND SCARIFIER ATTACHMENT

TWO MACHINES IN ONE

Real Road Building Economy

THE HUBER STEAM ROAD ROLLER

—with its unsurpassed **surplus of traction** power easily hauls graders, scarifiers and long wagon trains, thus eliminating necessity of separate hauling engines.
—Exceptionally strong in the belt, and furnishes most economical power for running of stationary machinery.

THE HUBER SCARIFIER IS

—attached to the rear axle which sustains all the pulling strain—ready for use the instant wanted—carried clear of ground and out of the way when not needed—tears up ground uniformly, regardless of the position of ground wheels—depth regulated by guides at either side—piston working against steam in a simple, independent cylinder gives cushion compression on spikes steam power raises spikes from ground as desired—a single lever operates it either way—works close to curb.

SEND FOR COMPLETE PARTICULARS

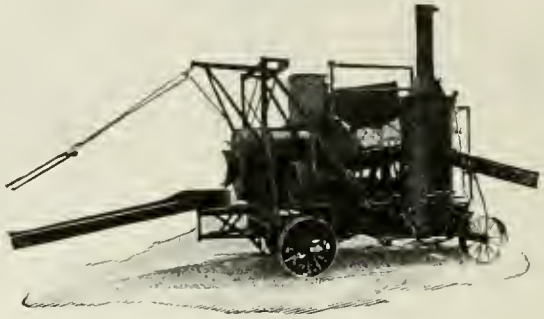
The Huber Manufacturing Co.

601 Center St. MARION, OHIO.

can distribute over a street 50 feet wide up to within 5 feet of outfit without moving.

A leading contractor operating this type of mixer on street paving work, states:

"We have cut our charging labor down to one man and are now using this same labor elsewhere. We use three carts, sometimes four, and in each cart are placed the necessary materials for one complete batch. This is all done at the material pile and it is then pulled to the mixer by a simple hoist with cable attachment, and charged into the mixer by one operation (see illustration). The carts are guided to and from the mixer by only one man. Figure it out yourself that if you saved five men's labor per day at $2.50 each, you would save $12.50 per day, or $287.50 per month of twenty-three working days. This estimate does not include the time saved by rapid charging. The use of a side loader requires several times relaying of the material to charge the mixer while with the cart charger you charge the mixer by only one direct operation.



NEW TYPE *of Standard Traction Paving Mixer.*

Marceline, Mo., Electric Light and Power Plant

The waterworks system was installed here three years ago, G. W. Sturtevant, of Chicago, being the consulting engineer of the work. The total cost was about $55,000.00.

At the time of the completion of the waterworks system, the electric light plant was purchased from the Marceline Electric Light Co., for the sum of $42,000.00, this to be paid in installments of $3,000.00 per year until the sum total is paid.

Within the three years of public ownership the yearly payments have not only been made but several thousand dollars have been spent in improvements and extensions and all from the earnings of the system.

The number of electric light consumers has been more than doubled. The water consumption starting from nothing has had a speedy growth until now about 200 consumers are using water, two of these, the A. T. & S. F. R. R. Co., and the Prairie Oil and Gas Co., being large consumers. About 5,000,000 gallons per day is the present consumption.

Our electrical equipment consists of one 100-k.w. Fort Wayne generator, 3-phase, 2300-volt, 60-cycle, connected to high-speed steam engine; one 62½ k.w. Fort Wayne generator, 3-phase, 2300-volt, 60-cycle, connected to gas producer engine; one 7½ h.p. Fort Wayne motor, 3-phase, used for compressing air for starting producer gas engine; one 50 h.p. Fort Wayne, 3-phase, 2080-volt, induction motor, connected to two double-acting triplex pumps.

L. A. NICKELL, *Superintendent Marceline, Mo., Electric Light and Power Plant.*

S. T. BRYCE J. W. BRYCE, S. D. BRYCE

PUBLIC AND PRIVATE BUILDINGS OF ALL KINDS EQUIPPED WITH
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Practical Heating and Ventilating ENGINEERS

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415-16-17-18 THE SPITZER.

Toledo, O. Feb. 24, 1913.

Kewanee Boiler Co.
Kewanee, Ill.

Gentlemen:

We are enclosing herewith a list of some of the public school buildings in which we have, during the past few years, installed steam blast heating and ventilating systems, and in which we have installed as part of the equipment, Kewanee Firebox Boilers

While this list may not be a complete list of all such installations that we have had, we believe that it will indicate to you very clearly our opinion of the merits of the Kewanee Boiler. Our experience justifies us in the belief and in the statement that, for the use to which we place these boilers, there is no other boiler on the market that is at all comparable with tht Firebox in all particulars.

The boilers listed are working under varying pressure ranging from 5 to 40 lbs., and their use has been entirely satisfactory, not only to ourselves, but to our clients in every particular.

While this boiler may not be the cheapest boiler to buy or install as far as first cost is concerned, we believe that when you take into consideration the reasonable price at which it is sold, together with the ease and low cost with which it may be installed and bricked in, and its adaptability to any kind of heating problem, we believe it to be absolutely the best and most satisfactory from the contractor's point of view, at least.

Another point which we regard very highly is the fact that it has a much lower water line than any other of equal merit. We find, also, that in actual operation they have demonstrated greater efficiency on lower fuel cost than any other type of boiler that we have used.

Another reason why we like to figure the Kewanee in our work is because we know that the Kewanee Co. is always there with immediate shipments, which is a great factor on rush work.

We have thrashed out the boiler question with ourselves pretty thoroughly in the last few years, with the result that wherever it is at all possible to do so, we use the Kewanee Firebox Boiler and nothing else. We expect to use more of these boilers during the coming season than in any previous season.

Wishing you a very prosperous year, we are,

Very truly yours,

JWB/A. THE BRYCE HEATING & VENTILATING CO.

KEWANEE BOILER COMPANY

Kewanee, Illinois

Steel Power and Heating Boilers,
Radiators, Tanks & Garbage Burners

Chicago St. Louis New York
Kaosas City Salt Lake City

The above motor is set on the extended base of the pump and will carry a 25 per cent. over-load for two hours without excessive heating.

Our rates on electric light are as follows:

Business houses for lighting, 12½c per k.w. hour.

Business houses for motors, 7c per k.w. hour.

Residence houses for lighting, 15c per k.w. hour.

A. T. & S. F. R. R. Co., for lighting, 8c per k.w. hour.

A discount of 10 per cent. is allowed on all business house bills under $5.00, and on all residence bills under $2.50 if paid before the 18th of the month, and 15 per cent. on all business bills over $5.00, and all residence bills over $2.50 if paid before the 18th of the month.

No discount is given on motor bills or the A. T. & S. F. R. R. bills.

The average gross income from the sale of electrical power per month is about $1,000.00 and about $800.00 from the sale of water, at present.

Following is a calculation of the cost of electrical power at the switchboard of the Marceline electric light and power plant, for the months of July, 1912, to December, 1912, inclusive—six months.

1—Total k.w. hr. consumed thru service meters	36,823
2—Total k.w. hr. consumed by flat rates	6,420
3—Total k.w. hr. consumed by water works electric pumps	80,010
4—Total k.w. hr. consumed by street lights, moonlight schedule	10,747
5—Total k.w. hr. consumed by office and power house lights	3,156
6—Total k.w. hr. consumed by transformer losses	9,092
7—Total k.w. hr. consumed in line losses	2,612
Total output	148,860
K.w. hrs. per month	24,800

Operating expenses of electric light plant for months of July, 1912, to December, 1912, inclusive, are as follows:

July	$ 639.02
August	648.20
September	706.28
October	1,049.61
November	965.72
December	956.30
Total	$4,965.13

In the above is included about $800.00 worth of extensions and improvements that would not ordinarily be considered as operating expenses.

Total operating expenses for 6 months	$4,965.13
Insurance on power house, lines, meters, etc.	123.75
Depreciation on same	1,000.00
Total operating expense for 6 months	$6,088.88
Total k.w. hours output, 6 months	148,860
Cost per k.w. hour at switchboard	$0.0409

L. A. NICKELL, Superintendent,
Marceline, Mo.

Elevated Steel Water Tank

By Charles W. Root, City Engineer, City of Lakewood, Ohio.

The city of Lakewood has just completed the construction of an elevated steel water tank for reserve purposes during rush hours, as the 12-inch supply mains leading from the city of Cleveland are not of sufficient size to supply us properly during those periods.

The materials, workmanship and inspection were in conformance to the general specifications for elevated steel tanks and stand-pipes by C. W. Birch-Nord, published by the American Society of Civil Engineers.

Regulator Valves

The valve equipment includes one 10-inch and one 6-inch regulator valve. The 10-inch regulator valve, with flanged ends, placed in the 12-inch supply main is adjusted so as to deliver water to the tank and to allow the tank to fill to any predetermined height, and close to prevent further inflow of water. This valve opens whenever pressure in mains is greater than the pressure on the tank side, except that when the tank is full the regulator valve remains closed in order to prevent overflow.

The 6-inch regulator valve with flanged ends is placed in the 6-inch by-pass and is so adjustable as not to deliver water to the tank but to deliver water from the tank at a predetermined point when the pressure drops on the supply main. This valve is also so adjustable that after opening to deliver water from the tank it remains open until the pressure on both sides of the valve is equal, and then closes. Each regulator valve operates within two pounds of the pressure for which it is adjusted.

The water tower is placed on ground the elevation of which above city datum is approximately 112 feet. The elevation of the water surface in tank when filled is approximately 182 feet. The regulator valve is placed at an elevation of approximately 106 feet. When the tank is full the pressure at the balve

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DUSTLESS **ODORLESS**
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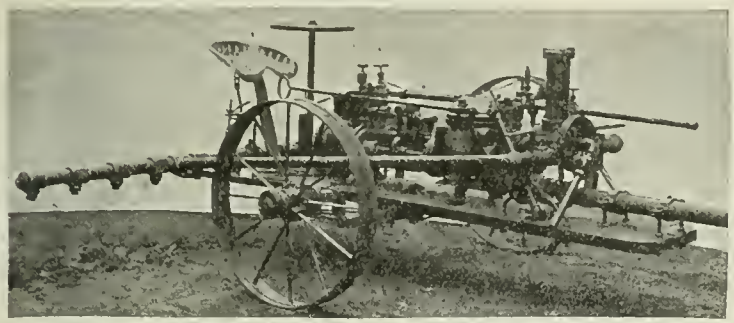

The Johnston Oil and Tar Spraying Machine Builds that Kind

The road which will give the greatest amount of satisfaction at the smallest cost for building and for up-keep is one of which the major portion, composed of broken stone, is held in place by an effective bituminous binder. Satisfactory results, however, cannot be obtained unless the binder is applied in such a way as to insure proper penetration and adhesion; in other words, a good binder may be spoiled through improper handling.

The only way which has so far been found to do this work economically and satisfactorily is by using a machine which will apply the binding material under such a heavy pressure that it is broken up into the most minute particles—or atomized—so that it is spread on the stone like a mist or dew, penetrating the remotest interstices of the stone, and covering each piece of stone on all sides.

The Johnston Oil and Tar Spraying Machine will do this work in the best possible manner at a minimum cost.

Of equal importance with the building of new roads referred to above, is the resurfacing of old worn out macadam roads. These roads can be made as good as new by the application of bitumen in a thin layer, covering this with a layer of grit, and so on with alternate applications of bitumen and grit, or what aptly has been called a "blanket treatment," until the road has been put in far better condition than when it was first built and at an expense which may be considered trifling in comparison with the results secured.

The Johnston Machine has been proven, after a number of years of use, to be the most efficient and economical for this purpose.

It will pay you to write us and let us tell you the advantages of this machine, both as to operation and results.

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Kent's Oil Heater and Forcer Unloads road oils or tars from tank cars at rate of 100 gallons per minute without the use of heating coils in the car.

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Heating Kettles All sizes and every possible style. The construction is the best and the prices are right.

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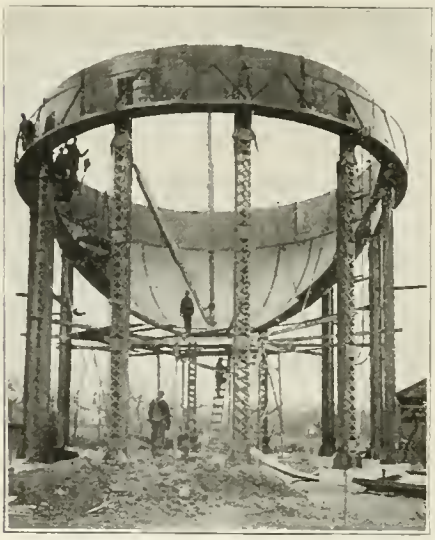
will be approximately 33 pounds. The 6-inch regulator valve is intended to be adjusted so as to deliver water from the tank when the pressure on the supply main drops to 20 pounds. Both the 10-inch regulator valve and the 6-inch regulator valve are adjustable to an amount not less than 10 pounds either way from the pressures mentioned.

Purpose of Tower

As before stated, the Lakewood water tower is designed to supply a sufficient quantity of water for the low service district in the city of Lakewood during the hours of greatest consumption from about 3:00 p. m. to 8:00 p. m. daily. This district is now supplied by one 12-inch main, one 10-inch main and one 6-inch main. These mains extend east and west in parallel lines and are each about three miles long, receiving the supply of water at their easterly ends from the mains of the city of Cleveland. These mains do not deliver sufficient water



LAKEVIEW TOWER *under construction.*

during the day to supply the district referred to, which contains a population of approximately 14,000 people. It is estimated that there will be sufficient pressure in the mains to fill this tower between the hours of 8:00 p. m. and 6:00 a. m. The tower will remain full until the heavy demand of the afternoon reduces the pressure in the supply main, when the valves will open and the water will flow from the tower for about five hours, or until the pressure in the supply main increases. The capacity of the tower is about 560,000 gallons. This tower is designed for use in summer only and for this reason no cover or roof has been provided and no provision made to protect the 12-inch supply main from freezing. The contract cost of the completed tower was $11,300. The supply line and valves cost $2,300, making a total cost of $13,600. The tower was erected by the Des Moines Bridge & Iron Company of Pittsburgh and Des Moines, according to plans submitted by said company with their proposal for building same.

The distance from the city limits (West 117th St.) to the water tower location on Warren road is about 8,000 feet. Assuming that we will during the night maintain an average head in our mains at Division pumping station of 200 to 210 feet, we can maintain a night pressure at West 117th street equal to a head above city datum of 195 to 205 feet, or say an average of 200 feet. Judging by our experience in the past it is estimated that the supply in the water tower will be drawn upon from about 3 p. m. to 8 p. m. or for about five hours. Estimating the probable number of consumers to be served from the tower at 8,000 and allowing per capita per day during these five hours, the rate of flow from the tower to the low pressure territory during these five hours would be 83,333, say 84,000 gallons per hour or 1,400 gallons per minute.

The diameter of the tower is 46 feet, therefore the water in the same equals 12,432 gallons for each foot in height, and if water is taken from the same at the rate of 1,400 gallons per minute, the water in the tower would be lowered at the rate of one foot in 8.88 minutes, or about 7 feet per hour. In five hours 33.75 feet of water, equal to 419,580 gallons, would be drawn from the tower, and the quantity would have to be replenished during the night, or say, from 8 p. m. to 6 a. m., ten hours. The head on our mains at the pumps will increase steadily from 8 p. m. to midnight, probably as fast or faster than the water will rise in the tower, so that it will be safe to assume an available head to overcome the friction in the 12-inch main in Detroit avenue equal to the difference between the top of the tower (i. e. 190 feet) and the average head at West 117th street (i. e. 200 feet) eqnal to ten feet. As the distance from West 117th street to the tower is approximately 8,000 feet, the available friction head per 1,000 feet is 1.25 feet.

A 12-inch main under this condition should deliver 675 gallons per minute, or 40,500 gallons per hour. Assuming that all water used by the consumers during the night is supplied by the other parallel mains and that the full capacity of the 12-inch main in Detroit avenue

Coral Builders and the Bell System

In the depths of tropical seas the coral polyps are at work. They are nourished by the ocean, and they grow and multiply because they cannot help it.

Finally a coral island emerges from the ocean. It collects sand and seeds, until it becomes a fit home for birds, beasts and men.

In the same way the telephone system has grown, gradually at first, but steadily and irresistibly. It could not stop growing. To stop would mean disaster.

The Bell System, starting with a few scattered exchanges, was carried forward by an increasing public demand.

Each new connection disclosed a need for other new connections, and millions of dollars had to be poured into the business to provide the 7,500,000 telephones now connected.

And the end is not yet, for the growth of the Bell System is still irresistible, because the needs of the people will not be satisfied except by universal communication. The system is large because the country is large.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
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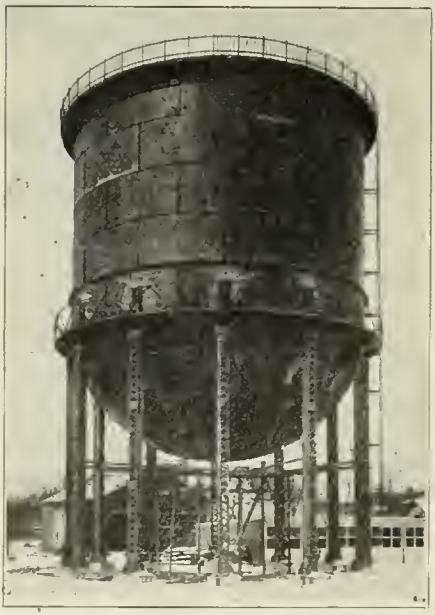
One Policy *One System* *Universal Service*

is available for water tower supply exclusively during the night, the estimated quantity taken from the tower in five hours, namely, 419,580 gallons, can be replenished in about ten hours, or by 6 o'clock a. m. In order to prevent water flowing from the tower before 2 or 3 o'clock p. m., it may be necessary to shut off a valve early in the morning and open the same in the afternoon. Otherwise there might not be sufficient water left in the tower for the heavy usage during the time of sprinkling, which is generally from 4 p. m. to 7 p. m.

The Driving of Rivets

At the time of our going over the original plans and specifications we had considerable controversy and discussion on the subject of driving rivets from the same side of the plate upon which the calking was to be done. The following statements will be of interest to engineers:

Morris Knowles, M. Am. Soc. C. E., civil engineer, Pittsburgh, Pa.—"I should say that the formation of the rivet head



COMPLETED 560,000-*gallon Lakeview water tank.*

should be made upon the side upon which calking is to be done, and as I understand that in the particular instance mentioned the latter is to take place upon the inside, this would mean that the rivets would be put thru from the outside and driven with the head upon the inside."

Samuel E. Duff, consulting engineer, Pittsburgh, Pa.—"I am inclined to say that the ordinary practice is to drive tank rivets from the inside, and I know of no reason why this should not produce satisfactory results. I have no objections to it unless some circumstances were present which I have never encountered in actual work. If the calking is done from the inside I should certainly require the rivets to be headed from the inside, also."

R. E. Brown, Division Engineer, Heyl & Patterson, Pittsburgh, Pa.—"From my experience in field work on some tanks and as shop inspector in a structural shop for a considerable length of time, I would say that it would be almost impossible to get a tight job by attempting to calk the original head of the rivet. By that I mean the head which was formed when the rivet was made and not the head formed when driving the rivet in the field. In order to keep the water from entering the seam, the riveter should be on the inside of the tank, because in that case with careful driving there would be no necessity of calking these heads. This differs from usual boiler practice in that boiler rivets must ordinarily be driven on the outside on account of the restricted space in the boiler, and in that case calking is also done on the outside, probably on account of accessibility and ease of inspection. In this case the water is actually present in the seam and around the rivet, which is a thing to be avoided in tank work if possible."

Wm. C. Coffin, Jones & Laughlin Steel Co., Pittsburgh, Pa.—"In reference to the calking of steel water tanks and the driving of rivets, I would say that I would favor the calking of the tanks on the inside and driving the rivet head on the inside also; that is, putting the rivet thru from the outside. I have been in the business of making water and oil-tight work for twenty-five years, and I do not know of any better procedure in order to get a first-class piece of work."

J. N. Chester, Chester & Fleming, engineers, Pittsburgh, Pa.—"In our specifications for water tanks we have never thought necessary to state that tanks should be calked on the inside but have always presumed on this being common practice, but should we have had occasion to dictate, we under the clause in our specifications which permits us to direct the work would most assuredly have compelled any contractor who sought to do otherwise to do his calking on the inside as well as forming all the rivet heads driven in the field. The rivet heads should be formed on the same side that the calking is done. The calking in all tanks where diameter will permit should be done inside, and it is only

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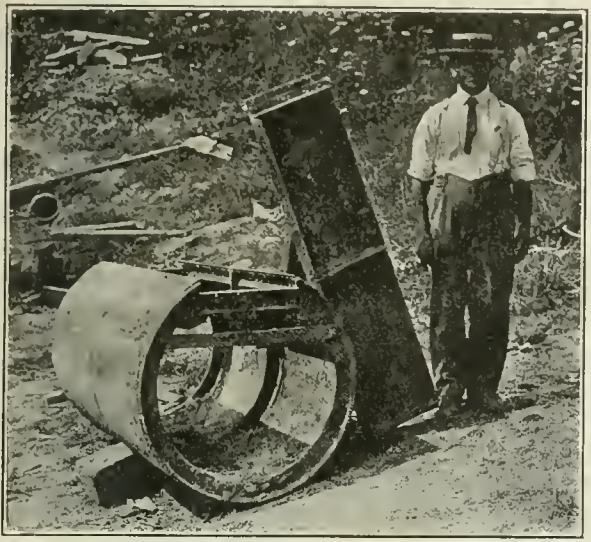

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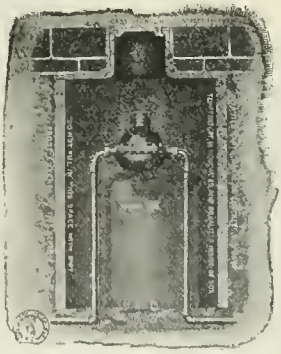
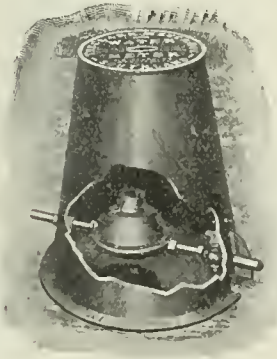


THE "SOUTHLAND"



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where the space on the inside is insufficient for the hammer men that outside calking and riveting is done under our specifications."

Resurfacing Old Pavements

Court Avenue is but one of the many streets in Memphis which have been resurfaced by this city with sheet asphalt, and the work done has been most satisfactory.

Many of these streets which have been resurfaced were paved with vitrified brick from 12 to 18 years ago. They began to fail seriously of late, and the questions as to what method should be used in repairing them was discussed at length by the Memphis Commission Government. "It was finally determined to use sheet asphalt on top of the old pavement," states one of the engineers. "We first filled holes in the old pavement with concrete. A paint coat was then applied to the hole to afford a contact between the old surface and the new asphalt top which had a thickness of two inches.

"There were altogether approximately 10,000 square yards of pavement laid on Court avenue, Monroe avenue, Union avenue, Gayoso avenue, Center lane and McCall place. The work was done by the Memphis Asphalt & Paving Co., a local firm.

"At the time when this work was done this method was not being very widely used and many inquiries have been received from other cities in the United States as to the success of the method. This class of work has since come to he recognized as one of the standard methods of street construction in handling old pavements thruout the country.

"The Lutz surface heater was used in the above work. This machine is specially adapted for resurfacing old pavements as well as for small patch work on asphalt pavements. For small patch work a 3x5-foot hood is furnished and by adjusting a jet blower that is located above the hood the heat can be drawn to any part of the pavement under the hood, thereby only melting that part of the pavement desired to be patched. About two minutes is required for this operation, another two minutes for the disintegrated parts of the pavement and one or two minutes for moving the heater, consuming about six minutes in the entire operation. Two laborers will consume about twenty minutes or more in chopping out and preparing the same space for patch, and when finished it has the appearance of a garment of many patches. The method of repairing and patching by chopping out the disintegrated parts is not only expensive but unsatisfactory because the hot material does not weld onto the old pavement altho it may be painted with liquid asphalt. There being no union between the old and new material, cracks open up admitting destructive elements, causing decomposition to set in, soon necessitating replacement. With the Lutz heater method the temperature of both materials being at the vulcanizing point, a perfect weld is produced, leaving a finished surface and, instead of it having the appearance of a patch, it becomes a part of the whole and the union between the old and the new pavements cannot be distingulshed after one or two days' traffic. The Lutz surface heater is made by the Equitable Asphalt Maintenance Co., Kansas City, Missouri."

Trade Notes

Colonel B. W. Dunn, of New York, chief inspector of the Bureau of Explosives and Combustibles of the American Railway Association, has been elected to membership in the Council of Underwriters' Laboratories. The work in safeguarding life and property which the railway companies have been carrying forward thru Colonel Dunn's bureau is similar in many respects to that undertaken by some departments of the laboratories. The addition of Colonel Dunn to the Laboratories' Council is expected to aid the establishment of uniformity in fire prevention engineering practices.

Messrs. Heap and Dighy, engineers, 48 Westminster Palace Gardens, London, England, have been appointed agents and engineers for Underwriters' Laboratories in Great Britain and Ireland. The establishment of a Laboratories' office in England is made in response to recommendations of the British Trade Commissioner in Canada, and in accordance with desires expressed by a number of manufacturers in England who are exporting goods which properly come within the scope of the examination and test work carried on by the Laboratories.

About 100,000 barrels of Universal portland cement will be used on the new Soo terminal in Chicago which extends from 12th to 16th street and is several blocks wide.

The National Incinerator Co., of New York, heretofore building small gas-burning destructors for household and hospital use have taken over the incinerator business of Lewis & Kitchen, of Chicago and Kansas City, and Samuel R.

Vol. XLV. No. 2. August, 1913. Twenty-five Cents.

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The World's Leading Municipal Publication

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***

CLARENCE A. KENYON *represented the American Highway Association and the Indiana Good Roads Association as a delegate to the International Road Congress, held in London, Eng., June 23-28, 1913. Mr. Kenyon is a practical highway engineer who has been engaged in road and street building for many years. He has studied and watched the rapid development of the science of road building in America in a manner so thorough as to mark him as an authority. For this reason he is particularly fitted to point out the many interesting facts brought forth at the recent London Congress, where three thousand delegates represented thirty-nine different nations.*

***

EUROPEAN ROAD BUILDING

By CLARENCE A. KENYON, *Indianapolis, Ind.*

FROM every country comes the cry, "What are we to do with our roads?" The increase of the travel on them has so multiplied that roads that were strong enough and good enough a few years ago are no longer adequate. What is to be done? Shall we neglect the roads until the public no longer uses them except when it is imperative? If we do the country falls into decay, tenants and workmen will not stay on the land, and the towns and cities adjacent thereto lose prestige and population.

Again, many of the roads were so poorly constructed and of such inferior materials that the cost of upkeep is so great we cannot raise the money to pay the expense of adequate maintenance. Must we reconstruct them, and if so how and with what materials, and how can we convince the taxpayers of the necessity and utility of so doing?

Such are the questions that I have heard engineers and road authorities ask in Spain, Italy, France and England as I passed thru those countries, and such are the questions that are on everyone's lips here in London at the International Roads Congress, at which there are thirty-nine countries represented by over three thousand delegates.

France has been, up to five years ago, the leading good roads country of the world, but France has passed to second place. Great Britain has passed her, and why? With the great increase of automobile traffic of various kinds it has been found that those macadam or gravel roads over which pass considerable traffic, no matter how well built, cannot be maintained except at a cost far in excess of any amount that the taxpayers will pay or the road authorities will levy, and yet these are the very roads that the public desire to use the most.

In France the local roads are practically as good as ever, but the surfaces of the heavily traveled roads are wearing out, not one or a few places, but over the whole surface. What can the patrolman do in such cases? He is not adequate for the task.

In England this condition has been met or is being met by tarring the roads. With infinite care and study they have discovered what roads can be successfully surface treated, the quality of tar required and the conditions of application. Where this is not enough, they have resorted to the penetration method or the mixing method as the traffic and conditions required.

While the French have used and are using tar or asphalt to some extent they have not been so successful as have the English.

IN ENGLAND *the taxpayers welcome road construction and improvements as a means of bettering local conditions and adding to local wealth.*

The English taxpayers have come to see the necessity for greater appropriations for reconstruction and upkeep, declaring that without the roads their country will be almost uninhabitable. They say that they have long since passed the point where it does any good to rail at the automobile, that vehicle is here to stay, then why not make the roads good? Make the auto owners help pay the cost, and treat them so well that they will come into your country, for the reason that they always leave some money there. Let us get them and their money and not drive them away, is the cry. We were in one small town in the interior of Wales that, five years ago, they told us was dead. It is now quite alive. We saw signs on practically every house offering "afternoon teas," luncheons, dinners or some article for sale.

The half tone on page 109 shows a road near Shrewsbury, in the west of England that costs $750 per mile per year to maintain, and the taxpayers feel it a good investment, although there are but few houses along it. This is an exceptionally good stretch of waterbound macadam road, but one patrolman can only take care of two miles working all the time.

Engineers and experts have gradually worked out the conditions under which tar, oil, or asphalt can be used successfully.

(1) The drainage must be good.

(2) The foundation of adequate strength and thickness to bear the traffic likely to use it.

(3) The surface crust must be hard enough to stand the traffic without breaking, and firm and clean and dry at every point before the bituminous substance is applied.

(4) If there are any depressions, potholes, waves, ruts or other irregularities they must be filled and compacted so as to provide an even surface.

It is a waste of money to place tar, oil or asphalt on loose sand or dust.' The money had much better be expended in reconstructing the surface.

It is almost axiomatic here that it is throwing money away to build or maintain a road, either above or below the necessities of the traffic that is likely to pass over it. The greatest care is taken to meet this rule, and the roads one sees testify to the thoroness with which it is carried out. There is a great corps of trained road men in England, Scotland and Wales. The county surveyor is a trained and enthusiastic highway expert, and the patrolmen under his direction become, in course of time, very efficient. I saw many that had been in the service for from five to sixteen years. The central road board or central authority prepares and sends specifications to the county officials and surveyors and aids them in every way to keep their work up to the highest standard. Working out road taxes has been abolished in England for three hundred years.

THAT *the interest in the road building movement is universal is shown by the attendance at the London Congress, at which every civilized nation in the world was represented.*

At the International Road Congress, which opened in London on June 23, every civilized country in the world was represented. There was a plethora of papers presented, there being some 140, which was cut down about a third for actual reading.

In Lloyd George's welcoming address he demonstrated the increase in highway traffic by reference to a secondary arterial road out of London which, twenty years

ago, had for traffic a few light vehicles and one or two heavy carts, but a few Sundays ago a traffic census showed the passage in a single hour of 100 bicycles, 50 motorcycles, 50 motor buses, 300 motors and 15 horse-drawn vehicles and on a week-day there would have been a number of heavy motor delivery vans. This means heavier maintenance cost, and the expenditures for this work have increased for the whole of England and Wales from £8,500,000 ($42,000,000) in 1892 to £15,500,000 ($75,000,000). The government has also made direct appropriations from the national treasury amounting to about $15,000,000 in the past two years, since the establishment of the national road board, for the construction or reconstruction of roads by modern methods, partly with the desire of reducing to some extent this high cost of maintenance.

DIVERSITY *of practice and lack of agreement among engineers upon basic principles of road construction are responsible for many costly failures the world over.*

Sir George Gibb, in his presidential address, called attention to the large number of unsettled questions in road building and maintenance which had arisen and are still arising from the change in the character of traffic under the new conditions, and to the great differences in practice and in opinions which would be shown by comparison of the papers presented by the representatives of the various countries. He expressed the engineering opinion in Great Britain as in favor of the use of tarry or bituminous substances in road making, in which his country is a leader.

The questions of planning new streets and roads, road surfaces for bridges and viaducts, bituminous macadam, wood paving, lights for streets and for vehicles, causes of wear and determination of roadways with results of the past five years' observations, regulations of speed of traffic, administration and financing of road departments, were taken up in sections and thoroly discussed. There were also many papers on details, technical and administrative.

The social features included many receptions and parties, garden, theater and river, and also a number of inspections and excursions and a large exhibit of road-making materials, methods and machinery.

A few sentences from papers and resolutions are appended, which may be of interest, tho American engineers will not agree with all of them.

If a road is too narrow the cost of maintenance will be increased out of all proportion.

Extensive road systems cannot be reconstructed within a reasonable time to carry motor wagons. A few important roads should be reconstructed and the wagons prohibited from using other roads.

The direction of streets should depend on the direction of prevailing winds. Streets must not be so arranged that they will be continually swept by winds nor be without shade in the hottest part of the day. The only direction in which a street should never run is north and south.

Long streets which seem to require to be built in straight lines should be given a certain amount of sinuosity.

In straight streets the picturesque can be secured by breaking the line of frontage by satisfactory grouping of important buildings and the disposition of open spaces.

AMERICAN *engineers can profit by an observation of conditions which already exist in the older countries and which are certain to obtain here within a few years.*

The rule that traffic should pass to the right is recommended, that being usual, tho in England, generally thruout Hungary, in the country districts in Italy and a few other places passage of traffic is to the left.

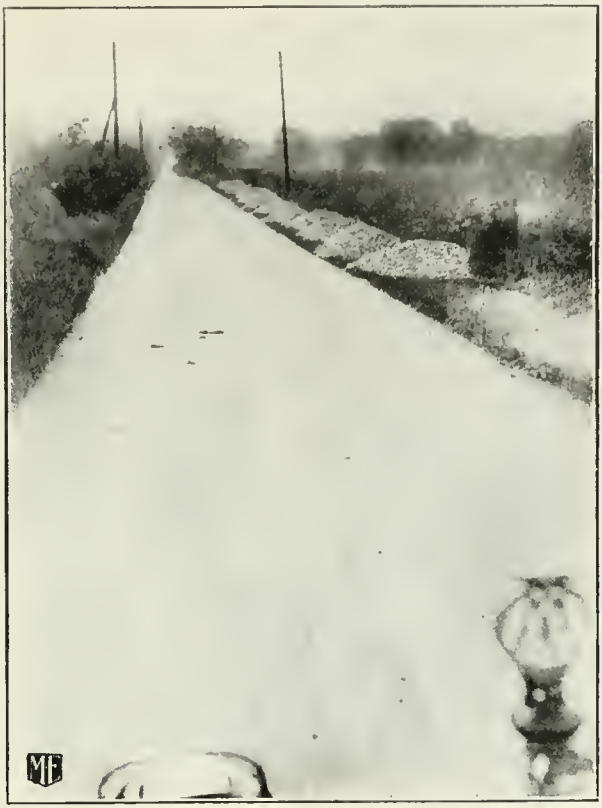
The radii of curves in roads used by fast traffic should, where practicable, provide an unobstructed view of 100 yards ahead, and where this is not possible means of clearly indicating approach to such short curves should be provided.

In German towns of over 50,000 population 89 use gas and 4 use electricity for

street lighting. One-fourth to one-half the lamps are kept burning all night.

A road should be lit by two-armed masts in the center of the street or by lamps suspended on wire ropes across the street. All temporary and permanent obstructions, including dangerous bends, should be lit.

Dr. Clayton H. Sharp, of New York, criticises rather severely the American ornamental lighting systems as inefficient tho garish, especially when arc lamps are used; an annoyance because set too low; as disturbing because they prevent discernment of less brilliant objects; and would use diffusing globes, hang lamps well above the field of vision, whatever that may be, suppress or divert the horizontal rays and make the proportion of vertical rays as high as practical considerations permit.



WATER-BOUND *macadam road near Shrewsbury, in the west of England. The maintenance cost is* $750.00 *per mile per year.*

It is impractical to light rural roads generally as urban streets and suburban roads are lighted and lights on vehicles using rural roads at night are therefore of the utmost importance.

All vehicles, whether standing or moving should carry lights or lighted lanterns visible both front and rear.

Every motor car should carry two lighted lamps in front and one in rear, and high-speed cars should also have a headlight strong enough to illuminate the road for 150 feet, this being shut off in city or town streets.

Cost of constructing and maintaining main roads should be paid by the state, that of by-roads should be distributed in part over the property or the local town, with some aid from the state and county, or corresponding subdivisions, according to German representatives.

The service of main roads should be completely centralized in the state department of public works, even those parts within the limits of towns and cities thru which main roads pass.

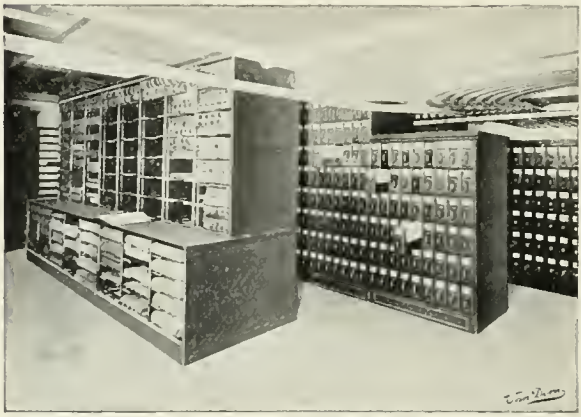
National trunk and county main roads should be aided by the state; county district roads should be cared for by the county or county borough, and local roads should be maintained by the local district rate, according to English representatives.

Arch bridges would receive same treatment as the street on which they are located. Pavements on other bridges should be as light as possible and waterproof.

By various contributors to the discussion tar macadam, asphalt, wood block, small stone setts producing kleinpflaster or durax paving are recommended and cobble stone is condemned, for bridges other than arches.

METALLIC FURNITURE INSTALLATION

THE new city hall of Chicago, Ill., is almost entirely equipped with metallic furniture, as is the Cook County court house adjoining. The more important types installed in the city hall should be mentioned—17,000 metallic document files, 4,835 metallic roller book shelves and 84 steel curtains, while metallic types installed in the Cook County court house particularly worthy of mention are 24,700 metallic document files, 19,500 roller book shelves and 259 steel curtains, covering approximately 54,000 square feet of surface.



ROLLER BOOK SHELF *and document file cases, City Hall, Chicago, Ill.*

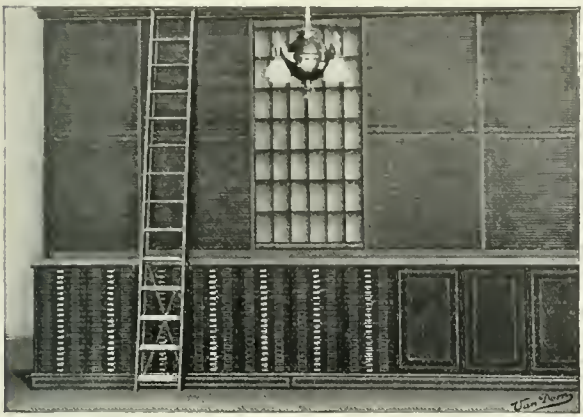
Cook county lost nearly all of its records in the fire of 1871 and for this reason was very careful in its selection of filing cabinets and vault fixtures in building the present court house. Nothing of record is filed in wood cabinets in this building and the papers and books are so divided by steel compartments that it would be impossible for a fire to spread from one compartment to another should by any chance one of them become ignited.

The specifications governing this work were extremely rigid, calling for heavier material, better construction and better cabinet work and workmanship than is customary on work of this class. The specifications call for an average of 2 gages heavier material than is usual in metal furniture equipment. Every piece installed was inspected and gaged by both the architects, Holabird & Roche, and the engineer in charge of the building, John M. Ewen. Some states require that all public documents, whether state, county or municipal, be kept in steel filing cabinets, for instance, Massachusetts. While Illinois has not adopted this law, the custom of keeping records in steel cases has become so general that for the past five years we do not know of a single instance where the governing body, thru their purchasing agent, has installed wood fixtures for this purpose, and as fast as their finances permit are

OMNIBUSES, *City Hall, Chicago, Ill.*

throwing out wood fixtures and replacing them with steel.

The original metallic furniture contract placed by Cook county totalled approximately $140,000. Additional contracts have since been placed for $10,000. The



PIGEON-HOLE CASE *covered by curtains. Base section, legal blank drawers and cupboards, City Hall, Chicago, Ill.*

first contract placed for metallic furniture by the city of Chicago totalled $104,977, but additional contracts for the same type of furniture have been placed since the original order, so that the value of the metallic furniture now installed totals $120,000.

The city hall of the city of Chicago and the court house of Cook county are located in the same building and the type of metallic furniture is the same thruout, valued at $270,000, making the largest installation of metallic furniture, both as represented by money and material furnished, under one roof in the country. Completion of the first contract for the city of Chicago was made in 1911. In accordance with the contract, the contractor, viz., the Van Dorn Iron Works Company, Cleveland, O., have made all repairs, which to date show only one repair item of $120 at 75c per hour for repairs on rubber tires on omnibuses. Repairs on installation in the county building, which was completed in 1907, have to date been $14.97.

Other similar installations are: The new municipal building at Des Moines, Iowa; state house at St. Paul, Minn.; court houses at Kankakee, Tuscola, Salem, Oregon, Monticello and Lincoln, Ill.; Rhinelander, Whitehall, Mauston and Chilton, Wis.; Sigourney, Mt. Pleasant and Orange City, Iowa; Memphis, Tenn., and Boston, Mass., and Hall of Records, Brooklyn, N. Y.

The uprights of the roller book shelf cases, which are of No. 10 gage steel, are punched with adjustment holes on ½-inch centers, located in front of the cases. The tops and bottoms are of 16 gage steel, except in those cases where the shelf extends to the base of the case, in which instances removable No. 24 gage dust pans are placed. The backs, which are of No. 22 gage steel, are flanged ½ inch at right angles to back and are bolted to the uprights. All uprights are faced with vertical ¾-inch brass tubes pivoted at ends and secured with steel brackets. These vertical rollers form a continuous line from the top to the bot-

VAULT INTERIOR, *City Hall, Chicago, Ill.*

tom of the space occupied by the roller book shelves and are polished to correspond with the front shelf rollers.

All cases over 7 files high are equipped with file handlers, and are also provided with horizontal and vertical 3/16-inch

steel wires extending thru the cases and drawn taut for the rigid bracing of the framing.

The outer faces of all swinging doors, which are built of No. 10 gage steel, are paneled and finished with drawn steel

ROLLER BOOK SHELF CASES, *Cook County Court House, Chicago, Ill.*

molding, all over 2 feet in height being equipped with a three-point locking device.

All of the sliding doors roll on two or more 3-inch brass wheels attached to the back of the door or concealed in bottom rail, and so arranged as to operate on grooves formed by ¼ by 1-inch brass bars. All sliding strips, guides and similar friction members are of brass. Wherever two or more sliding doors enclose the front of the case these doors are so arranged that one door slides in front while the other slides behind in order that practically the entire front of the case may be opened at one time.

All curtains are of the simplex or duplex type and are constructed of No. 24 gage steel, slats being ⅝ of an inch wide. The edges of these slats are stiffly beaded, one edge being sufficiently larger than that on the other edge to permit the slipping of the strips into one another so as to form a smoothly working hinge; the entire curtain thus forming a continuous flexible sheet with water-tight, smoke and dust-proof joints. Ball-bearing steel pulleys are placed at the top and bottom and are so connected with the two leaves that the closing of either leaf will also close the other. The ends of omnibuses are of No. 10 gage steel, while the backs of same are of No. 16 gage steel. The battleship linoleum tops are supported on No. 10 gage steel false tops and bound around the edges with small brass channels or angles. Wheels are constructed of red fibre, equipped with anti-friction roller bearings. Rear wheels are 12 inches in diameter and are spaced to carry two-thirds of the load. Front wheel is 5 inches in diameter and is secured with a solid box frame.

The legs of tables are formed from 2-inch steel angles tied together and braced with ¼ by 1-inch steel bars, placed 10 inches above the floor. All aprons are 5½ inches deep, built of No. 16 gage steel and reinforced. The table tops are formed of battleship linoleum, supported on No. 12 gage false tops, bound around the edges with brass angles.

The stringers of all ladders, which are either hung from the ceilings or supported

PLAIN SHELVING CASES *covered by sliding doors, City Hall, Chicago, Ill.*

from the tops of the cases, are built of No. 16 gage metal, with a ¾-inch roll at both edges. The steps are constructed of No. 16 gage with ¾-inch rolls at both

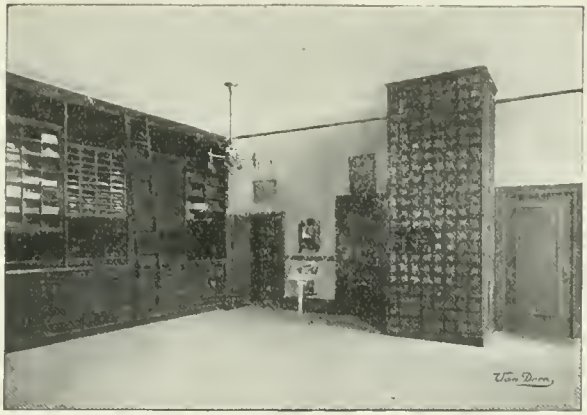
edges and flanged at the end. All ladders extending from the floor to the ceiling are provided with standard 1¼-inch diameter enameled gas pipe hand-rails and uprights on both sides. The tracks are built of No. 24 gage steel. All ladders are equipped with rubber tires and cast-iron wheels at the bottom and at the top with ball-bearing hangers.

The safes are constructed of two thicknesses of metal, the outside sheets being No. 10 gage and the inside lining No. 20 gage; the space between the two casings being filled with ½-inch asbestos board. The doors are built in the same manner and are equipped with heavy brass-tipped hinges, four-tumbler combination safe locks, numbered dials, etc.

The fronts of all document file cases have a raised panel and the sides are folded back 2 inches at right angles to the top and firmly riveted to the file body. The tops of the file heads are double folded for strength and finished, while the bottom of the heads are flanged at right angles and firmly secured to the bottom. Wherever possible the sides and bottoms of the bodies are formed from one piece of metal. Bottoms are stuck down on each side in order to form runways and are slotted in the center for the compressor slide. All document file heads have a countersunk space where handles are secured in order to insure additional strength. The compressors, which are built of malleable iron, slide in the grooves in the bottom of the file. All document file cases are equipped with bails formed of ⅝-inch No. 14 gage metal riveted to the rear end of the slides of the file body. These cases are equipped with flanged shelves in each opening in order to form strike so as to engage the bails at back of each file.

The sides of all flat letter files are cut in the form of a triangle and these files are so arranged that when pulled from the case they are suspended at the back from ⅛ by ½-inch steel bars; these files hang down in a vertical position, suspended hooks being provided on the inside of the uprights.

All legal blank drawers and map-tube cases have drop fronts riveted to the sides, and are so pivoted that when the drawers open the front drops down. The card index drawers are equipped with a pan suspension, while all other drawers have a bolt suspension except where less than 16 inches deep. The plan drawers are equipped with flanged hoods at the backs, which are bent forward horizontally in order to prevent the curling of the drawings. All plan drawers are built of No. 20 gage and are provided with a hinged hood in front. The bottoms of plan, legal blank and plain drawers have two 1-inch finger holes near the front in order to prevent the operators raising the end of the paper in the drawer from underneath.



SUPERINTENDENT OF PUBLIC SERVICE OFFICE,
Cook County Court House, Chicago, Ill.

The sides and bottoms of all vertical letter files are No. 22 gage steel, built with double heads, allowing ½-inch air space.

The upper edges of both sides are folded for strength and appearance and both sides and bottom are flanged and secured within the head by means of a ⅛ by ⅝-inch bail band, riveted to the sides and bottom at the rear. These files have a No. 16 gage steel following board arranged to lock with a friction grip and to operate with a lever. Each file is provided with a roller suspension in order to support same when drawn entirely

from the case. These extensions are built entirely of metal, but patch travel by the roller is so constructed as to deaden all noise. The stops on all vertical letter files have composition or rubber tips in order to deaden the noise of operation.

The roller book shelves are constructed of ⅛ by 11/16-inch steel bars in sections riveted together and with cross bars which support the front rollers. All front bars have a re-entrant or square bend midway between the rollers in order to afford a convenient method for grasping the books. The shelves are so arranged at the rear that they can be secured with pins or bolt to the holes in the uprights. Each roller book shelf has not less than eight rollers, the two front rollers being formed from No. 18 gage seamless brass tubing ⅞ inch in diameter, while the rear and intermediate rollers are built of No. 20 gage steel seamless tubing ¾ inch in diameter. These rollers, which are 5 inches in length, are so located as to project ⅛ inch above the shelf form; the rear rollers projecting slightly more than the other rollers. Front rollers are finished to match the hardware, while all other rollers are so enameled as to match the cases.

All scoop files open at the back, the sides being cut out at an angle of 45 degrees and the edges folded, leaving the bottom the full depth of the case. Each file is equipped with a spring compressor, which is riveted to the inside of the top.

All library stacks are built with U-shaped No. 16 gage steel plates, with a ⅛-inch steel web plate, the uprights being slotted at 1-inch intervals; the slots extending to within 2 inches of the back in order to receive the shelves. The end plates have an inner plate of No. 16 gage steel and exterior plate of No. 13 gage steel rounded in front. All uprights have a ¼-inch steel plate at the bottom in order to distribute the load. All shelves are constructed of No. 16 gage, stiffened front and rear by ⅝-inch rolls, arranged to receive the book supports. The ends are formed with a ½-inch projecting bearing to engage in slots.

All vertical book stalls are constructed of No. 20 gage steel cut back 2 inches for a distance of about two-thirds of the height of each division and have neatly rounded corners for grasping the books.

The horizontal shelves of all bin cases are turned up along the front edges at an angle of about 45 degrees, the flange being constructed so as to allow an opening 7 inches wide between the upper side of the upper shelf and the top of the flange of the lower shelf.

American Road Congress at Detroit.

How to systematize the purchase of road equipment and materials will be explained in a paper to be read by Henry G. Shirley, chief engineer of the Maryland State Roads Commission, at the American Road Congress which will be in session during the week of September 29, at Detroit, Michigan. This paper deals with one of the many important subjects to be treated by experienced engineers, public officials and road contractors at the big meeting.

The Maryland Commission has been working out the problems of good road administration in a most painstaking and thorough manner and Mr. Shirley's paper will undoubtedly present some interesting conclusions.

Col. A. E. Stevens, state highway commissioner of New Jersey, will have a paper at the Congress on the treatment which he has found most effective for worn out or traveled macadam surfaces. New Jersey was the first state to adopt the state aid plan for road construction and consequently has a large mileage of water-bound macadam roads which are being adapted to new traffic conditions.

"The Merit System in Road Administration," will form the subject of an address by President John A. McIlhenny of the United States Civil Service Commission, and will undoubtedly attract nation-wide attention. Political favoritism incompetence and indifference characterize the administration of our public roads so generally as to cause a loss estimated by some experts as high as $40,000,000 a year. Mr. McIlhenny's paper will show the demoralizing effect of political domination in road management and point the way to an efficient system which will mean skilled supervision, continuous and practical service and due economy.

PIECE WORK SYSTEM

applied to

CITY FORCES

CONSTRUCTION of municipal work by day labor under the direction of the engineering department is sometimes successful and economical when properly administered, but here is a plan which has some new features and the article describing them will be interesting even to those who do not agree with the position taken by the author. He would say, "do not condemn it until you have given it a fair trial."

By J. E. TUPPER, *City Engineer, Pomeroy, Wash.*

WHEN the city of Pomeroy, Wash., was about to install its sewerage system the question of how it should be done, whether wholly by contract, partly by contract and partly by the city, or wholly by the city, was an important one and caused much discussion. We had no local contractors capable of handling the work and we were averse to letting the work to contractors from other places, even though there might be an apparent saving by doing so. The previous experience of the city in doing its work with city forces had been so generally satisfactory that the council was strongly in favor of that method if some means could be devised of overcoming the one apparent defect in the system. While we had some men who would do as good work for the city as they would if working for a private individual, or even for themselves, a large number of the laboring men are inclined to take it easy when working for the public, and a by no means negligible element will "soldier" whenever and wherever possible. In all of the previous undertakings of the city the crews had been comparatively small, and it had been possible to eliminate the undesirable element, either by refusing them work when their traits were known, or by discharging them as soon as they began shirking.

In preparing for the installation of the sewers it was evident that a new factor entered the problem. The necessary force would be so much larger than any previously assembled by the city that we would need every available man, and would probably need to import some. Now, while the crew was small we could pick our men without causing much hard feeling, and even if a man was discharged for inefficiency but little trouble was experienced, because his place was taken by another home man. When, however, it comes to replacing home labor with imported labor the matter becomes serious and the offense would need to be flagrant to justify it.

It is well known to engineers and foremen that the efficiency of any crew is gaged very closely by the efficiency of the poorest man in the crew, and the example of one or two shirks will often have a disastrous effect on the discipline and efficiency of even the best of crews.

The problem that confronted us was that of employing all available home men, importing as few laborers as possible, and doing this without reducing the efficiency of the force below that of a picked crew.

The nature of our work was such that the employment of machinery to any considerable extent was impractical. Our water supply system, if system it could be called, is such a maze of pipes, the location of which is unknown, that the employment of a trenching machine would result in such utter demoralization of the water supply that the expense of repairing breaks in private pipes or cutting out

and replacing them would more than offset the reduced cost of trenching. The water mains had been placed without any survey or record of location. In one case where the sewer location presumably paralleled a water main for 2,600 feet at a distance from the main of three feet, we found the water main in our trench for nearly one-third of the distance, and it crossed our trench eight times.

We knew that these conditions existed and had a very good idea of the obstacles we would be likely to meet. The conditions were not favorable for letting a straight-out contract for the trenching. It was certain that a large portion of the trenches must be dug by hand and the amount that might possibly be better handled by a machine was too small to warrant bringing in a machine for the purpose. In the purchase of supplies the city was in position to secure fully as advantageous terms as any contractor could possibly get. The manner in which the pipe was laid and the back fill tamped was of such paramount importance that we felt that the city should retain full control over the workmen who were doing this work. This could only be secured by having the work done by city forces.

AFTER deciding to have the work done by city forces, reluctant consent was given to the piece-work method of payment on trench work only.

After a full canvass of the situation in all of its phases the council decided to have the work done entirely by city forces. It was then up to the engineering department to devise some scheme for overcoming, in part at least, the most objectionable features of that system.

The writer suggested the piecework method of payment and advised its application to as much of the work as could be done without too much trouble. Many doubts were expressed as to the feasibility of the plan, and the council seriously objected to allowing it to be applied to the pipe-laying because of the danger of the work being slighted.

After considerable discussion the council agreed to allow a test of the method to be made on the trenches only, all other work to be done by day labor. The trenches could be handled by the new method more easily than any other part of the work, and if there should be any tendency to slight the work on the part of any of the workmen it could be easily corrected without endangering the perfection of the sewer. The accounting was a simple matter. Cross timbers for alinement and level purposes were set by the engineering force at 25-foot intervals, thus dividing the trenches into convenient one-man sections. The records of the engineer's office gave the amount of excavation in each 25-foot section, and a single setting of the slide rule gave the compensation. There was a little additional bookkeeping involved, but no complications. A simple method of numbering the sections was adopted by means of which each man could keep track of the sections excavated by him, and the location of each section could be quickly determined if its number was given. The engineer's record was kept in the ordinary field book, and as there would be no embankment that column was used for entering the compensation for that section computed on the earth excavation basis. As the timekeeper's reports came in, the name of the one excavating a section was entered under the head of "Remarks." In this way complications were rendered impossible and omissions were quickly run down.

As fast as the classification reports came in from the engineers they were entered on the same book and the proper compensation correction for each section was entered in red ink. The credits shown on the field book were transferred to a single-entry ledger and payments made biweekly. We found that tho the accounting took a little more time than the day wage system, it was negligible as compared with the advantages that were found to accrue from the new plan.

We had very little data from which to determine what would be a fair scale of prices. Taking what we had, because of it being something of an experiment at best, preferring to be liberal in our prices, we fixed the following scale: Excavation per cubic yard: Earth 15c, hardpan 30c, loose rock 60c. What solid rock

we encountered was excavated by day labor men. The amount was small. As it was a little doubtful whether we would be able to secure as many men as we needed for the trenches at these prices, it was announced that if, after a two weeks' trial it was found that the prices were too low to enable the average man to earn ordinary wages, then we would either increase the schedule or return to day wages. With this encouragement enough men were secured to begin operations, and before the first week ended the success of the plan was assured. In fact, the trenchers were able to earn such wages that we were forced to increase our day wage scale in order to hold the men we wanted on the other work. While at first glance this might seem to be a disadvantage, in actual practice it proved to be the reverse.

THE example set under the piece-work system enabled a corresponding increase in the efficiency of day-wage forces.

It gave us the advantage of a sliding scale in place of an arbitrary one. Our minimum wage was $2.50 per eight-hour day. When a day wage man wanted to go in the trenches we had this option. If he was a poor or indifferent worker we would let him go, but if he was a desirable man we would increase his wages to a price that would hold him. If a man was found shirking or slighting his work we would manage to get him in a position where there would be nothing for him to do just then except to go ahead into the trenches, and once in the trench, he would not get on the day wage force again. On the other hand, if there was a man in the trench that we wanted on the day force we could usually secure him. In this way we were able to keep a force of select men, and there was practically no complaint of unfairness or favoritism.

There was much less of this than we expected, and as they had but two grounds for complaint, yardage and classification, it was very easy to get rid of them. As a whole the trench men were perfectly satisfied with the deal we gave them. We were very liberal in our classification, were not unnecessarily insistent on having the sides of the trenches trimmed to line, and when unusual difficulties or obstructions were encountered we either gave them extra pay or took over the section to be excavated by the day men. There were a certain number of the trench men who were kept there thruout the entire job. They were worth more there than anywhere else, both to themselves and the city. These men averaged $4.00 a day or more, one of them averaging $5.00. Their example was a stimulus to the entire trenching force. To watch the twenty or more men we had in the trenches for one day was one of the best object lessons on the relative efficiency of common laborers that I ever received. The incentive for efficient work was the same in each individual case. Each man knew that he would get full pay for what he accomplished, and no more. And yet the variation in the amount of the day's work was astonishing. It ranged from 16 to 35 yards of earth in an eight-hour day.

SAVING muscle at the expense of the brain is a quality not usually attributable to the day laborer, but piece-work pay developed it to a degree in some of the men.

So great a variation must have some reason for its existence. As a rule the ordinary foreman would not see enough difference to warrant a remark. To all appearances the men were working equally hard and on the whole with equal diligence. I want to cite three typical cases. We will call them Jones, Brown and Davis. Jones was a husky specimen of the laboring class, above the average in intelligence, especially shrewd and quick to catch on to short cuts and ways of saving his muscle at the expense of his brains. As a day-wage man he was the most persistent, unscrupulous and shrewd hand at "soldiering" that we had in the city. Working in the trenches by the yard, he drew down the largest pay checks of any man in the crew. He worked no harder than other men, but he knew how to make every move count, and, having no incentive for shirking, he kept his shovel in motion. He spent no time talking, looking around or loafing on the job. He sim-

ply worked intelligently and persistently. The only chance to get ahead of the job was in the width of the trench, and these he dug as narrow as he dared. Sometimes he overstepped the limit and had to be called back to trim up, and he always did so cheerfully. He was never a "kicker."

Brown was another husky man. He was the equal of Jones in intelligence, but was less shrewd and more conscientious. He knew how to take advantage of his work and could, for a short time, move dirt as rapidly as Jones could. The trouble with him was that he could not keep from talking and could not talk and work. As a result he spent but little more than half of his time in actual work, and though his pay check was up to the average, it was not what it ought to have been if he had only been reasonably diligent.

Davis was probably the best man of the three, physically and intellectually, but he was inherently so abominably lazy that he had never learned to work and was the despair of all foremen. He was kept in the trenches because he was not worth his salt in any other place, and we did not want to actually discharge him. Placed where he had to earn his money, he did make an effort to hold his own, but tho to all appearances he worked harder than either of the other men, he was barely able to make minimum day wages. He had plenty of strength, but did not know how to apply it. He failed because he had no system, failed to give any thought to the way he was trying to do the work and was actually too lazy to use his brain to save his muscle. The same condition existed all along the line.

Now as to the results of the experiment as it affected the interests of the city. The first marked advantage was that noted above, the opportunity that it gave us of weeding out the undesirable workers from the day wage forces. The next and undoubtedly most important feature was the marked esprit-du-corps that grew up rapidly in the entire force. It started with the emulation among the trenchers and extended rapidly back through the day-wage men. The knowledge that every man would be expected to "make good" or lose his position was very soon disseminated thruout the force, together with the further certainty that each man would be paid according to what he was able to accomplish, whether he worked in the trenches or by day wage, at least so far as we were able to adjust the compensation under the system pursued. This spirit was so marked and the stimulation that it exerted over the entire force was so great that we would have been decided gainers financially even if the actual cost of the trenching had been more than it could have been contracted for. As a matter of fact the cost was about four cents per yard below what we could have hoped to get it done by contract.

THE experimcnt proved beyond question the practicability of piece-work payment upon classes of work where a unit of measuremcnt is easily applicable.

The unanimous verdict was that the experiment had proved an unqualified success and the only regret was that we had not applied it farther than we did. It is very evident that it would be impracticable to attempt to put all of the city forces on the piecework basis, but it was the consensus of opinion that so far as it was practicable to apply the system it should be done. The city will on the whole get better work for this reason. The foreman or inspector is anxious to keep the unit cost down and will frequently pass up shabby work rather than put the city to the expense of making it good when it has been done by day-wage men, but if it was done by piecework he would insist on having it made good before certifying the job up for payment. Then the men themselves are much better satisfied. They get pay for what they accomplish. If there are any strikes under such a system it is because the employer is trying to squeeze out that last penny. The unit price should be such that the poorest man in the crew could make average wages. The cost would then be little if any more than under the day-wage plan, while the men would be getting so much more that there would be no incentive for a strike, and the indirect gains to the employer would be ample to warrant the adoption of the plan.

MUNICIPAL LIGHT AND WATER PLANT AT FREMONT, NEB.

FREMONT is a city of approximately ten thousand inhabitants. Its growth has been comparatively slow, the population in 1890 having been 6,700, and in 1900, only 7,200. That a municipally owned plant can be operated successfully in a city of this size and under competitive conditions is particularly significant of the possibilities of municipal ownership.

By H. J. BREMERS, JR., *Assistant to Water and Light Commissioner, Fremont, Neb.*

IN the year 1907 it became apparent to the Board of Public Works of the city of Fremont that the facilities for handling the light and power business of the municipal light plant were inadequate. As a result an election was held for the purpose of considering the advisability of installing new and up-to-date machinery. The election carried and with it bonds for financing the same.

HENRY J. BREMERS, JR.

A competent consulting engineer was employed, who immediately drew up plans and specifications for a three-phase, twenty-three-hundred-volt, sixty-cycle system, and within a short time contracts were let.

Prior to this time a direct current system had been in vogue and had for a number of years proven satisfactory, but the demand for an increased capacity of current required that the system be alternating, both for efficiency and convenience.

The first installation was made in the boiler room, and consisted of a battery of three vertical water tube boilers of 250 horsepower capacity each, a feed water heater and purifier of 1,000-h.p. capacity, two feed water pumps, each 12 by 7 by 10 inches, and a pump 8 by 5 by 10 inches. This latter pump was installed for a two-fold purpose, namely, that it could be used for pumping water to the boilers at times when they needed washing and rimming, and for pumping the overflow of warm water from the condenser to the Y. M. C. A., which is but a short distance from the plant, where it could be used for plunge-bath purposes. For experimental uses a hot-water meter was placed in the feed water line. Stokers with Dutch ovens were installed in connection with the boilers, while directly in front of the stokers and above the hoppers, a tramway was built leading to an hydraulic hoist. A doorway was cut in the wall of the building at the bottom of the shaft to open into a huge coal pit, 100 by 18 by 8 feet, which has a capacity of about 300 tons. It was found necessary to have a pit in place of the coal sheds, as the city was unable to purchase the adjoining property at a reasonable figure.

The roof of the pit was made of common concrete and was reinforced with steel beams, the walls and floor having been finished in cement. At convenient places in the roof manholes were made, thru which the wagons might dump the coal. At the mouth of the pit a large scale was installed, over which all the cars of coal might pass and weigh prior to being placed on the hoist. A pit was likewise built underneath the ovens, thus the tram cars could be rolled to these places, loaded, rolled from thence to the hoist, elevated and dumped into a chute, which was built for the purpose of conveying ashes to the ash bunkers.

DESCRIPTION of EQUIPMENT.

After preparations had been made for developing steam, two generating units were installed, the largest of which consisted of a 2-300-volt, 63-ampere, 150-r. p. m. Fort Wayne generator, direct connected to a cross-compound engine of the horizontal type. The smaller unit consisted of a 2,300-volt, 31.5-ampere, 225-r. p. m. Fort Wayne generator, direct connected to a tandem compound engine of the horizontal type. Each of these units were then connected to a 500-horsepower surface condenser, the pumps for which were of the combined air and steam type.

For excitation of the generators a motor generator set consisting of a 30-h.p., 8-ampere, 2,080-volt, 900-r. p. m. induction motor, direct connected to a 20-kilowatt, 160-ampere, 125-volt, 900-r. p. m. direct current generator, was installed to be used constantly; while for cases of emergency, when the plant might be shut down temporarily, a simple engine 6 by 6-inch was direct connected to a 20-kilowatt, 160-ampere, 125-volt, 450-r. p. m. Fort Wayne direct current generator.

For a few years the capacity of the new plant proved to be sufficient, but as business increased it became necessary to install another unit. For this reason a 2,300-volt, 157-ampere, 3,600-r. p. m. turbo-generator was purchased. This machine is now used to handle the night load and is run condensing, being connected to a 500-kilowatt jet condenser, while the older units are run in parallel to handle the day load. The condenser connected to the turbo-generator is operated by two condenser pumps of the centrifugal type, which are driven by a direct connected, 40-horse power, 320-volt, 1,130-r. p. m. alternating current motor. The turbo-generator has given great satisfaction and likewise has proven very efficient.

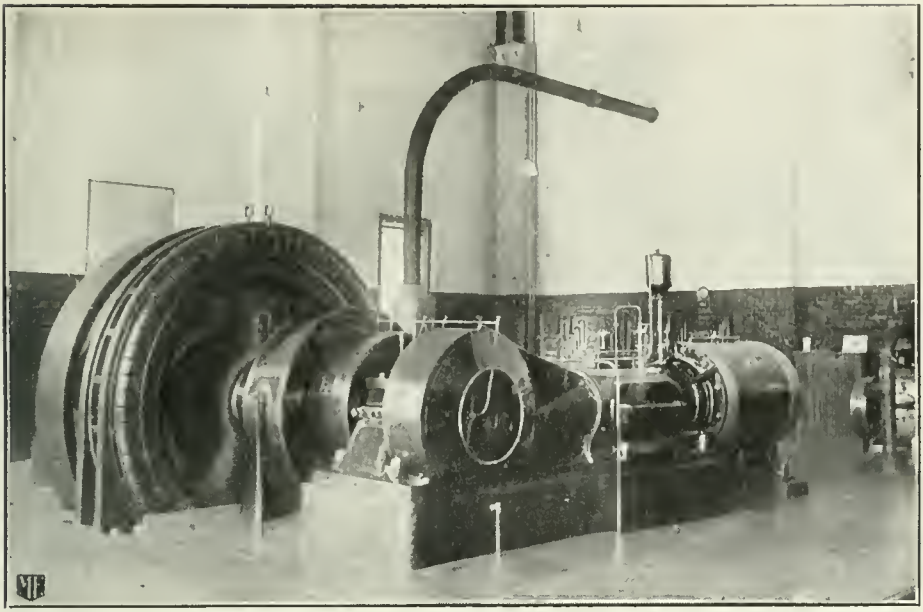
Two years ago, under the supervision of the water and light commissioner, an electrolier lighting system was installed in the commercial district. This system consists of 125 posts or standards, with five upright lights on each standard. The four lower lights are of 60 watts capacity each, while the center or upper lights are of 100 watts capacity each. Shortly before the installation of this system an ordinance was passed requiring that all poles, horizontal electric signs or other obstructions, be removed in the commercial district. This ordinance caused general underground construction on the part of the telephone company, the Fremont Gas and Electric Light Company and municipal electric light and water works, thus making the streets much more attractive than formerly.

THE PUMPING SYSTEM.

The water works consists of two steam pumps of the cross-compound, horizontal type, the largest of which has a water cylinder 15 by 22 inches and steam cylinder 14 by 28 by 22 inches. The smallest pump has a water cylinder 12 by 18 inches and steam cylinder 12 by 18 by 21 inches. These pumps have been in service since the water works was first installed, and are the only remnants left of the old plant. The larger pump does duty continually, while the smaller one is used for cases of emergency only. A pressure of 40 pounds is kept on the water mains, with the exception that during a fire the governor of the pump in service is so arranged as to maintain an 80-pound pressure.

The following rates are in vogue for light, power and water at the municipal plant:

Current for residential lighting, 8c per kilowatt hour; for commercial lighting, 6c per kilowatt hour; small motors for



FORT WAYNE *electrical equipment as installed in the municipal electric light and water works plant at Fremont, Nebraska.*

intermittent service, up to 5-horsepower, 4½c per kilowatt hour; motors for constant service thruout the day, up to 5-horsepower, 4c per kilowatt hour; motors running at least nine hours and using from 5 to 10-horsepower, 3½c per kilowatt hour; all sizes of motors above 10-horsepower, 3c per kilowatt hour; electric ranges or large heating apparatus, 3c per kilowatt hour.

The water rates are 15c per thousand gallons of water furnished up to 50,000 gallons per quarter year; to consumers using 50,000 gallons to 100,000 gallons per quarter year, 13c per thousand gallons; to consumers using 100,000 gallons to 200,000 gallons per quarter year, 10c per thousand gallons, and to consumers using over 200,000 gallons per quarter year, 8c per thousand gallons; minimum rate, $1.50 per quarter year, payable in advance.

The present lighting and power load of the municipal light plant has increased from about 100 kilowatt hours, in 1907, to 480 kilowatt hours in 1913. These figures show that there has been a decided increase in business, especially so if the factor of keen competition on the part of a rival public service corporation is worthy of consideration.

Motor Trucks in Municipal Contracting

The cost per ton-mile is the only logical basis on which to compare the Motor with the Horse.

By H. W. PERRY, New York City.

EXAMPLES of the successful application of motor trucks to large city contract jobs might be given indefinitely, but those cited in previous issues of MUNICIPAL ENGINEERING probably will suffice to satisfy anyone that the power vehicle has certain peculiar advantages that make it a most efficient tool in the hands of the contractor. But its desirability in any business is dependent to a great extent upon its ability to perform its work cheaper than it can be done by any other means.

Some motor truck experts hold that the motor truck and the horse cannot be compared, because the motor truck can do many things that are impossible with horses. And this is largely so, because, for example, a contractor can rush a job to early completion with motor trucks and win a large bonus or avoid a penalty; or he can secure contracts from competitors by guaranteeing to finish a job in less time than they can. Such factors do not enter into comparative costs, yet they are very important considerations. However, there is a fair basis of comparison in the similarity of work done, as in handling a certain quantity of material a given number of miles. This can be reduced to a ton-mile rate in both cases, the time factor and other considerations being ignored.

Innumerable tables of operating costs have been published by truck manufacturers and by periodicals devoted especially to this subject and they are available to all who desire to investigate the matter further. Most such cost records apply to one particular make of vehicle, to a particular job and location, so that the figures are not directly applicable to a case having different conditions.

The only way of arriving at a safe ton-mile cost basis for general use is to obtain the records of expenses of a large number of trucks engaged in different services in different localities over a period of years, and reduce the figures to averages. Such averages will then apply to normal service and allowance can be made for unusual conditions by anyone contemplating using motor trucks.

Several years ago the Hewitt Motor Company compiled a table of maintenance and operating costs of a large number of its trucks and for comparison printed with it a table of costs of equivalent horse service. The Knox Automobile Company did the same for its trucks, and it is interesting to observe that the average daily cost of trucks of approximately the same capacity was very nearly the same as determined by these two companies. The data are summarized in the tables, Nos. 1, 2 and 3, reprinted herewith.

LOCOMOBILE *steel demountable dump body, operated by power from the engine, showing rollers and rails.*

TABLE 1—OPERATING COST OF HEWITT TRUCKS.

Fixed Charges—	1-Ton	2-Ton	3½-Ton	5½-Ton	7-Ton
Price of truck	$1975	$2725	$3750	$4800	$5325
Driver, $16 to $22 per week	832	936	1040	1144	1144
Garage	240	240	300	300	300
Interest, 5 per cent	99	137	188	240	267
Insurance, fire, theft, liability	150	170	195	220	232
Depreciation, 15 per cent, less 1 set of tires	270	375	510	635	690
Variable Expenses—					
Tires	355	490	710	1150	1420
Total repairs	300	400	500	500	525
Gasoline, at 12c	290	360	430	480	500
Oil, at 30c	40	50	80	85	90
Total yearly cost	$2576	$3158	$3953	$4754	$5168
Average daily cost	$8.58	$10.53	$13.18	$15.85	$17.23
Miles per day	80	70	60	50	45
Average ton-mile cost	21c	15c	12½c	11⅝c	10½c

TABLE 2—HEWITT TABLE OF COMPARATIVE COSTS OF HAULING BY HORSES AND MOTOR TRUCKS.

Cost with horses—		Tons per load	Miles per day	Miles Loaded	Ton Miles	Cost per ton-mile
1-horse wagon	$ 4.00	1	22	11	11	36 c
2-horse wagon	6.00	3	20	10	30	20 c
3-horse wagon	8.00	5	18	9	45	18 c
Cost with motor trucks—						
1-ton truck	8.50	1	80	40	40	21 c
2-ton truck	10.50	2	70	35	70	15 c
3½-ton truck	13.00	3½	60	30	105	12½c
5½-ton truck	16.00	5½	50	25	138	11⅝c
7-ton truck	17.00	7	45	23	161	10½c

TABLE 3—OPERATING COSTS OF KNOX TRUCKS, BASED ON AVERAGE RESULTS OF SEVEN YEARS' USE.

	2-Ton	3-Ton	4-Ton	5-Ton
Price of truck complete	$3500	$4125	$4300	$4550
Fixed Charges—				
Driver, $15 to $22 a week	850	900	1000	1100
Garage	225	230	250	280
Interest, 5 per cent	175	206	215	228
Insurance, fire and liability	140	160	180	190
Depreciation, 15 per cent., less tires	454	531	538	565
Variable Expenses—				
Tires	742	936	1170	1250
Total repairs, less tires	350	400	450	500
Gasoline, 12c a gallon	225	260	300	360
Oil, at 30c a gallon	30	40	45	50
Total yearly cost	$3191	$3663	$4148	$4523
Average daily cost	$10.60	$12.20	$13.80	$15.00
Miles per day	70	62	55	50
Average ton-mile cost	15c	13c	12½c	12c

TABLE 4—COST OF OPERATING SINGLE AND DOUBLE TEAM IN BOSTON.

	One-horse team	Two-horse team
Driver's pay per day	$2.00	$2.50
Feed per working horse per day	.90	1.80
Rent and stable expenses per horse per day	.31	.62
Shoeing and small repairs per horse per day	.19	.38
Claims, accidents, tools, etc	.18	.36
Foremen's and lumper's pro rata	.18	.36
Other helpers per horse per day	.20	.40
Repairs, harness and painting	.13	.26
Manager's or Superintendent's salaries per day	.10	.20
Office rent, telephones and clerks	.31	.62
Miscellaneous, veterinary, etc	.24	.48
Fire and accident insurance	.08	.16
Depreciation for renewals of horses	.20	.40
	$5.02	$8.54

Few contractors or other users of teams know what it costs to do work with horses. They very rarely keep separate accounts of their teaming expenses and would be unable to ascertain actual costs if they tried. There was so much diversity of opinion on this subject among the members of the Team Owners' Association of Boston that a year or two ago the association asked W. H. S. Jarvis, at the head of a firm of certified public accountants, to give them the results of his experience from auditing the accounts of various trucking companies. As an example of the cost of using horses, Table 4 was worked out from the expenses of a large drayage concern, showing that the average cost was $5.02 a day for a single horse and wagon and $8.54 a day for a double team:

Allowance is made in the foregoing table for 61 idle Sundays and holidays in the year, and for sick and spare horses, bringing the total of unproductive horses up to 10 per cent.

HAULING *penstock 60 feet long and 5 feet diameter with 4-ton Peerless truck and trailer, in service of Manchester, N. H., water works. This truck was operated every day continuously during the past year, except when undergoing overhauling and repainting last March, and covered 16,000 miles in the year.*

Now, roughly, experience has proved that motor trucks average from three to four times as much work in a given time as horses, so that one truck at, say $15 a day, should be equivalent to three or four teams at $25 to $30.

Reducing horse and motor truck work and costs for comparison we get the following results:

TON-MILE COST OF HORSE AND TRUCK HAULAGE.

Capacity tons.	Cost per day. Horse.	Truck.	Miles per day. Horses.	Trucks.	Ton-miles per day. Horses.	Trucks.	Cost per ton-mile. Horses. Cents.	Trucks. Cents.
1	$5.00	$8.50	20	*75	†10	†37½	50	22 2/3
3	8.50	12.25	15	*55	†22½	†82½	38¼	14 3/4
5	8.50	15.00	12	*45	†30	†112½	28 1/3	13 1/3

*Actual running time, 5 hours per day, idle time figured at 50 per cent.
†Loaded one way only, returning empty each trip.

It will be seen from this theoretical calculation that haulage by motor trucks costs less than one-half as much as haulage by team.

The foregoing comparison is based on the actual charges per day for horses and teams as made by teaming contractors in different cities and similar charges for the use of motor trucks with drivers. The daily mileages credited to horses are in excess of the mileages claimed for them by their owners, while the truck mileages are conservative, being calculated on the standard speed ratings adopted last year by the National Association of Automobile Manufacturers. The rating for a 5-ton truck is 9 miles an hour. This is multiplied by 5, as it has been determined that in average service the truck is standing still nearly 50 per cent. of the 10-hour working day, so that it covers only about 45 miles a day. The average rate of travel of horses is three to four miles an hour, so that they have a working capacity of about 15 to 20 miles a day.

In practice, it is possible to cut down the idle time of the motor truck materially by loading and unloading methods, as has been pointed out in the specific services dealt with in preceding articles. The accompanying detailed record of the work done by two 5-ton Locomobile trucks used by the Bridgeport Hydraulic Company for five months for hauling cement, shows that the ton-mile cost ranged from 7.4 cents to 14 1/2 cents and averaged 9.4 cents.

The Pittsburgh Contracting Company, which is using thirteen motor trucks on the Catskill aqueduct job in New York, estimates that it is saving 30 cents per cubic yard by the use of power vehicles.

The economic possibilities of motor trucks in contract work, even where the hauls are short, are illustrated by the service of eight 3-ton Packard trucks used by the Oscar Daniels Company in the construction of the Lexington avenue subway in New York. Working eight hours a day, these trucks average twenty trips a day of 1 1/2 miles each. It was found possible to so arrange the work that the trucks could haul loads both ways at each trip, thereby doubling their efficiency. They

METHOD *of loading Speedwell trucks by gravity—a method which eliminated costly delays and kept trucks moving almost constantly.*

COST OF OPERATION OF TWO LOCOMOBILE 5-TON TRUCKS BY BRIDGEPORT HYDRAULIC COMPANY

	Month	Variable Expenses	Fixed Charges: Garage	Driver	Interest	Insurance	Depreciation	Total	Miles	Cost Per Mile	Tons	Cost Per Ton	Cost Per Ton Mile	Number of: Trips	Days
Truck No. 1	April	$ 56.63	$ 7.50	$45.00	$5.56	$4.54	$49.13	$168.26	535.0	$0.314	185.5	$0.907	$0.133	39	15
	May	83.06	15.00	81.00	9.92	8.12	88.00	285.10	1,037.0	.275	362.0	.788	.109	73	23
	June	65.24	15.00	75.00	9.92	8.12	88.00	261.28	1,151.0	.227	380.0	.686	.091	76	25
	July	70.86	15.00	90.00	9.92	8.12	88.00	281.90	1,495.6	.188	496.0	.566	.076	101	26
	August	62.97	15.00	88.00	9.92	8.12	88.00	272.01	1,466.0	.185	490.0	.555	.074	97	24
	September	218.91	15.00	94.00	9.92	8.12	88.00	433.95	1,624.0	.266	561.7	.775	.104	110	25
Truck No. 2	April	70.99	10.00	57.00	6.87	6.60	60.69	211.15	606.7	.348	245.2	.861	.145	52	19
	May	91.00	15.00	82.00	9.92	8.12	88.00	294.04	1,135.8	.259	240.4	.864	.106	70	23
	June	42.65	15.00	76.00	9.92	8.12	88.00	239.69	1,095.7	.218	344.5	.695	.091	73	24
	July	67.84	15.00	89.00	9.92	8.12	88.00	267.88	1,438.8	.186	473.0	.564	.078	96	23
	August	118.94	15.00	91.00	9.92	8.12	88.00	330.98	1,348.0	.245	459.0	.719	.098	91	24
	September	200.34	15.00	97.00	9.92	8.12	88.00	418.38	1,667.0	.251	582.4	.719	.098	114	25

TOTAL COST OF OPERATION

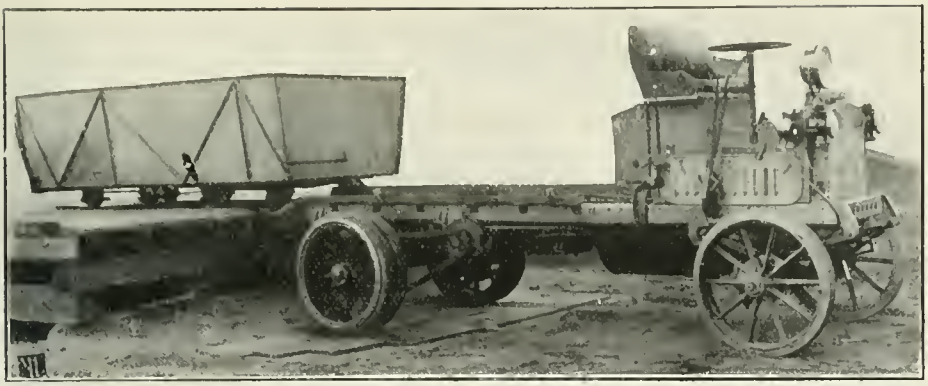
	No.	Variable Expenses	Fixed Charges	Total	Miles	Cost Per Mile	Tons	Cost per Ton	Cost per Ton Mile	Trips	Days in use
	2	$ 681.76	$1,180.36	$1,762.12	7,292.0	$0.242	2,444.5	$0.721	$0.098	496.0	141.0
	1	554.78	1,144.93	1,792.50	7,308.6	.233	2,475.2	.688	.093	496.0	138.0
Total		$1,136.54	$2,325.29	$3,464.62	14,600.6	$0.237	4,919.7	$0.706	.....	992.0	279.0
Average per truck	..	568.27	1,162.64	1,732.31	7,300.3	.....	2,459.8	.....	.....	496.0	139.5
Average per day	..	4.07	8.34	12.42	52.4	.....	17.6	.....	.....	3.6	.....
Average per mile	..	.078	.159	.237	.....	.....	.....	.....	.....	.....	.....
Average per ton mile	..	.....	.....	.094	.....	.....	.....	.....	.094	.....	.....

sometimes covered 40 miles a day, making a total of 120 ton-miles in eight hours. Where there are long loading delays, it is the practice of the company to assign one driver to two trucks, thereby effecting further economy. While one truck is being loaded the driver takes the other truck with its load to be dumped. Regarding the saving effected, Traffic Superintendent Roberts, for the company, says:

"The cost per yard for hauling with horses is 23 cents, and the machines have reduced this figure to approximately 13 cents."

FLEET *of Speedwell trucks used on a contract for* 10,000 *ton-miles of haulage on construction of dam for hydro-electric plant at Big Meadows, Cal. The six* 6*-ton trucks are estimated to have displaced* 270 *horses and* 40 *drivers. Cost,* 9 *cents per ton-mile vs.* 58 *cents with horses.*

A most unusual proof of the economy of the motor truck is furnished by a test made by engineers connected with McMahon Bros., road contractors of Mt. Washington, Md. To determine the relative capabilities of the motor truck and horse flesh in hauling stone for road construction and the comparative cost by the two methods, a 5-ton Mack truck and a 4-mule team were operated for one week doing the same work on the same joh. The work was hauling crushed stone from the company's Dickeyville quarry. The mule team hauled 4 1/2 tons and averaged three trips a day over a 9-mile route. The truck carried 5 tons and averaged six trips a day, making a detour to avoid a weak bridge which lengthened the route to 10 miles. There was a 1-mile ascent of 14 per cent. on the loaded trips, and rain fell during three days of the test, making the roads soft and muddy. Basing calculations on the data obtained, and including all items of operation and maintenance, such as interest on investment, insurance, depreciation and so forth, and figuring 225 working days per year, it was estimated that the cost of hauling with the mules was 13.9 cents per ton-mile and with the motor truck was 9.9 cents, so that the saving effected was 4 cents per ton-mile.



LOCOMOBILE *demountable dump body being deposited on a platform. The body is run on and off the chassis by power from the engine, a method which avoided having trucks idle at any time.*

In this connection the accompanying table of comparative costs issued by the Knox Company is of particular interest. The data were compiled by the New England Auto Co. for one of its clients and are declared to be unbiased. The manager of the engineering department of the audit company, who is a member of the Society of Mechanical Engineers, made an exhaustive research, some of the results of which are embodied in the tabulation. The data here given pertained to a job on a large contract involving the haulage of dirt on a 2-mile route and loading from chutes into special dump bodies.

It seems needless to multiply examples of the successful use of motor trucks by contractors in municipal work. Any reputable manufacturer of these vehicles will gladly furnish numerous instances to the interested inquirer and, if given particulars, will make an estimate of operating costs of his trucks in any kind of service and on any particular job.

TABLE 6—KNOX COMPARATIVE COSTS OF HAULING WITH HORSES, TRUCKS, TRACTORS ANDTRAILERS.

Equipment and Investment—					
Horses, 16 at $850, $5600; 8 wagons at $500, $4000	$ 9600				
Truck, one 6-ton		$6000			
Tractor, one 10-ton, $3750; 1 wagon, $850			$4600		
Truck and trailer, 16-ton				$6600	
Tractor and trailer, one 10-ton, $3750; 1 wagon, $850; 1 trailer, $900					$5500
Fixed Charges—					
Interest	$480	$273	$210	$303	$256
Insurance	290	241	221	250	234
Depreciation	1056	785	727	870	822
Drivers	6000	1092	1092	1092	1092
Stable-Garage*	4160	300	300	300	300
	$11986	$2691	$2550	$2815	$2704
Operating Charges—					
Maintenance	$ 1152	$576	$432	$600	$540
Gasoline		960	1047	873	960
Oil, grease		152	209	175	192
Tires		990	720	825	600
Total expenses	1152	2678	2408	2473	2292
	$13138	$5369	$4958	$5288	$4996
Work performed and cost—					
Capacity, cubic yards		3½	8	7	16
Trips per day	4	12	12	10	10
Earth hauled, cubic yards	24000	12600	28800	21000	48000
Ton-miles	64800	34020	77760	56700	129600
Cost per cubic yard	54¾c	42½c	17¼c	25¼c	10½c
Cost per ton-mile	20¼c	15¾c	6½c	9¼c	4 c

*Includes cost of feeding horses.

MOTORIZED HAULING SERVICE

By WELLINGTON WALKER, *Secretary and Treasurer Griswold & Walker, Inc., Forwarding Contractors, Chicago.*

ONE of the most important requirements of successful truck operation is to adapt the truck to the work it must do. Without that a good truck is as unsatisfactory as a bad one. There are business requirements for which the one and three-ton trucks are best adapted, and it is folly to use a five-ton truck in such cases; consequently, for the information of those contemplating the purchase of motor-driven trucks, we would advise that requisite time be spent in determining just what capacity trucks can be used to the best advantage.

To employ motor trucks to advantage they should be a means of saving the owner money. They must be cheaper to keep than horses. They must cost less to operate than it costs to maintain a large stable.

CARE *and intelligent operation have much to do with effecting the fullest economies with motor trucks.*

Motor trucks should be intelligently driven and intelligently cared for. There is no economy in cheap drivers or inattention to trucks. In any of the important centers the companies who are getting the greatest satisfaction from motor truck service will tell you: First, get the right trucks, built by the right company; put the right man in the driver's seat and give the right attention to the truck, and it will pay big interest on the transportation investment.

We have been operating two motor trucks furnished us by the Kelly-Springfield Motor Truck Co., Springfield, Ohio, since last March. While these trucks are rated as being of one-ton capacity, we are carrying two-ton loads almost constantly. They have been operated constantly since the time of purchase with practically no up-keep or maintenance repair expense. They cover an exceedingly wide area thereby increasing the radius of delivery, and enable us to reach out and get business beyond the horse zone. Consider further the limitations on horses in the winter, in the summer and in rush seasons, periods when trucks run along as usual, unaffected by the strain of long hours, the sizzling heat or the cold. Horses slip down on ice-coated streets and get stuck in the snow. Gasoline trucks perform as consistently in the face of these conditions as at other times.

Motor trucks cut down stable space required by more than one-half and do away with all unsanitary conditions, and so cut down overhead expense, and if it becomes necessary to seek housing for motor wagons far from the base of operation, little is lost, for they can be run to the scene of work in much less time than a horse would make the distance.

Truck users at first tried to apply the same truck to all conditions, with the result that in many cases motor trucks were not satisfactory. Now the manufacturers are building different size trucks for all different kinds of work. The heavy, cumbersome five-ton motor truck is not suited for lighter forms of work, and is not economical on that class of work. We are using our two Kelly one-ton trucks for one and two-ton loads, but will shortly purchase a three-ton Kelly for still heavier work.

A SAVING *of 15 to 40 per cent. as compared with horses is one of the strongest arguments in favor of motor trucks.*

To determine how much money in a particular case a motor truck can save over horses calls for an analysis of conditions, of short cuts via the motor truck, time-saving devices, rerouting of hauls, blue printing of the delivery system and

charting of the horse methods. The saving possible by trucks may run all the way from 15 to 40 per cent. in a year, depending on the nature and volume of hauling done.

The time is nearly here when municipalities and contractors will wonder why they ever indulged the fallacy of judging motor truck and horse from the same standard. The motor truck really occupies a new and distinct place in the transportation scheme. Besides doing all that the best horse ever could do, and doing it better, it accomplishes duty heretofore delegated to railroads, and also much in interurban traffic that never before was performed by any agency. The prospect who has not kept accurate track of his feeding, stabling, grooming, veterinary, blacksmithing, repairing and the multitude of items in horse upkeep will, if he is reasonable, look to the general and perfectly obvious service superiority of the motor truck. He will first take notice of the fact that truck users, almost without exception, never go back to horses; that they are perfectly content with its economies.

The accompanying table shows the way in which horse wagon drivers wages in Chicago have gone up during the last few years:

Type of Wagon.	1902	1908	1910	1913
Single, 1 horse.	$11.00	$11.50	$12.00	$13.50
Single, 2 horses	12.75	13.50	14.00	15.50
Double, 2 "	13.75	14.50	15.00	16.50
Double, 3 "	15.50	16.00	17.00	18.50
Double, 4 "	16.50	18.00	18.00	19.50
Double, 6 "	18.50	20.50	20.00	21.50

Overtime (year 1912), 30 cents per hour up to 8 p. m.

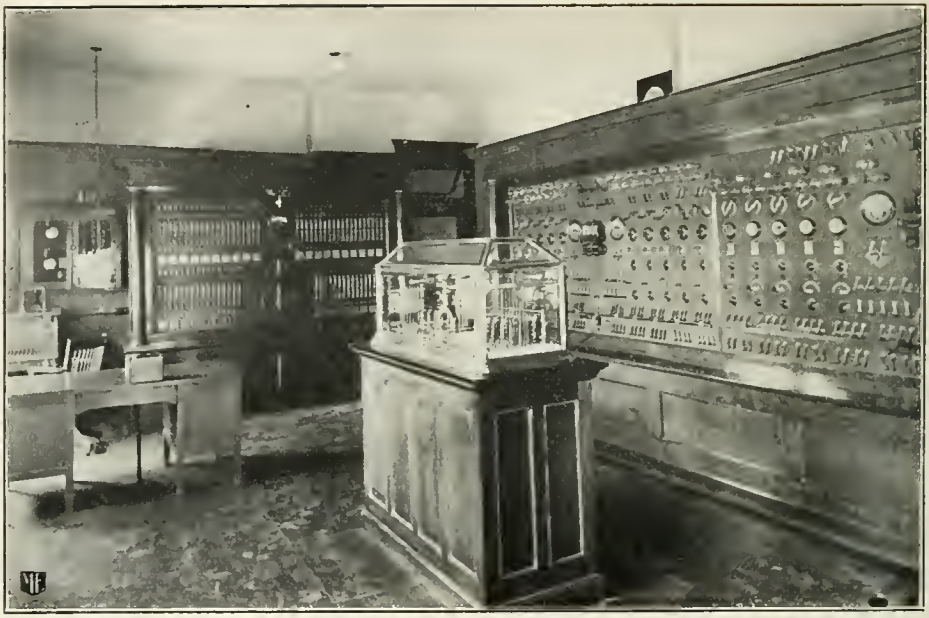
In Chicago the chauffeurs' union has recently affiliated with the horse wagon drivers' union, and the machine drivers have been assigned a regular scale of wages somewhat higher than that of the horsemen. But there is hardly a motor-wagon operator of prominence in the city who does not pay much higher wages than the scale. The reason is obvious. The machine drivers have to handle expensive equipment, and by good and conscientious work they can make more money for their employers. But as one motor truck driver replaces anywhere from two to six or more drivers, there is a great saving in the wage account, although the drivers do make more money.

Our four warehouses being located in four widely scattered parts of the city requires considerable hauling. Deliveries to the warehouse are, of course, made in carload lots, but all materials and supplies must be delivered from the warehouses to widely scattered parts of the city. We very frequently receive from thirty to forty delivery orders per day from one firm. These concerns desire speedy deliveries and if it were not for our rapid means of transportation we would be compelled to tie up a great deal of capital in horses and teams.

GOOD *wages and the fixing of responsibility upon the drivers arouses individual pride.*

Our Kelly trucks insure prompt and efficient service. We employ colored men as operators. Both of these men are experienced chauffeurs and to one we pay $20 per week and to the other $17.50 per week. These are very good wages but we deem it best to secure the services of men who really know their business. The $20 a week man is made responsible for the operation of both trucks. These men take pride in their work and the trucks are almost as attractive and handsome in appearance as when first purchased. We experience no trouble in their operation.

Their simplicity of construction, the easy adjustment of all parts, together with the advantages of the transmission and the accessibility of the motor insure constant service at a minimum expense. In spite of our $30 wheel tax, $15 express license, state license, taxes and other fixed charges, such as 6 per cent. interest, 20 per cent. depreciation, garage, fire and liability insurance, also tire and gasoline, oil and grease, our trucks are costing us less than $7.50 per day. These trucks are doing heavy service work continually, using about seven gallons of gasoline per day. Our maintenance and overhead charges are almost nil.



SWITCHBOARD *room at central fire station, Fort Worth, Texas—the most important link in a system which was carefully planned and has been notably successful. Shown by courtesy of the Fort Worth Star-Telegram.*

FIRE AND POLICE ALARM SYSTEMS OF FT. WORTH

By W. R. BIDEKER, *Chief Fire Department, Fort Worth, Tex.*

OUR electrical fire and police alarm system installed at a cost of $50,000 is very efficient. From 176 fire and police alarm boxes located at street intersections in every part of the city, connections may be had with either police headquarters or the central fire station at a moment's notice. There are seventy of the boxes in the business district—the territory extending from Bluff street to the Texas & Pacific station and from Monroe to Jones. Each alternate corner has a fire box and each a police box attached to the White Way lamp post.

An alarm may be turned in from any fire box by breaking a tiny square of glass and pulling down the lever behind it. The police boxes are principally for the use of the patrolmen, only a few citizens possessing keys. These boxes have phones connecting with headquarters. An officer who is wanted at headquarters on short notice may be summoned to a box for instructions by a clanging electric gong in the daylight and at night by a light flashed into the transparent globe at the top of the lamp post.

At both the central fire hall and the police station there are complicated signal boards where trained operators on duty every hour are watching the signal boards. A call for aid thru either the fire or police boxes or by public telephone brings instant response.

This system, apparently simple but in

reality replete with intricate details, was worked out by City Superintendent of Fire and Police Alarms Selwyn Smith and the writer.

It was built with the idea of taking care of Fort Worth for twenty-five years. Five months were required to complete the plans and three separate systems were worked out and discarded before a satisfactory one was evolved. The work of installation was begun in January, 1913, and finished in July.

SIX WAYS *of* SENDING IN ALARM.

There are now six ways in which an alarm may come to the central fire station. The alarm may be phoned over the lines of Fort Worth's systems or from a police alarm box. It may be sent in automatically by the street corner alarm box, the sprinkling system installed in many large business houses, and the A. D. T. watchman service.

When an alarm is rung in from any of the boxes, it goes first thru a delicately adjusted repeater so arranged that it can handle two alarm at once. The repeater sends it to all of the stations on the circuit of the box rung in. In all of the stations the firemen leap to their posts in readiness to go to the scene of the conflagration in case of a second alarm.

The alarm passing thru the repeaters also rings a gong at the city waterworks for a signal to increase the pressure in the water mains from 50 pounds to the square inch to 100 pounds. At the tap out signal sent in from the pulled box, whenever the fire is out, the pressure is restored to normal.

Telephone alarms come direct to the switchboard where sits the operator, perhaps the most important cog in the entire system. The efficiency of the department and very often lives and valuable property are in his hands. He must know the exact locality of each fire hall. He must be more familiar with the streets than with the interior of his own home, for it is his duty when he receives a call to pick out the nearest fire station and transmit the report there in a fraction of a minute.

He must have a knowledge at all times of the wherebouts of every piece of fire apparatus in the city. As the train dispatcher controls the traffic of his road, the fire-alarm operator must direct the movements of every fire engine and every hose wagon. He depends absolutely upon his own judgment regarding the necessity of sending one crew here and another there. He is literally the keystone of the fire department, night and day. A stringent rule requires a report to the operator if any piece of apparatus is for any reason out of service for more than three minutes.

EACH CREW *moves* NEARER FIRE.

When the alarm is first turned in, the operator transmits it to the three stations nearest the locality from which the report comes. In the business district, and in the outlying sections upon a second alarm, the crew from the station the least remote from the fire answers the call. The men from the station nearest to this one move into the vacated quarters. The third crew comes to the house deserted by the second. Thus it is that reinforcement in case of a second alarm can be easily called upon.

Firemen, when they answer an alarm, immediately commandeer the nearest telephone and notify the central station of its number. The latter must remember this and in case necessity arises, get in touch with the men at the fire. Firemen will take possession of a private phone if necessary. A private residence in this way sometimes becomes for the time being a fire station, officially considered.

The protection afforded by the installation of the new system and the improvement of the fire department generally in the last few years is thoroughly adequate. Engine houses in the business district are all half a mile apart and no business house is consequently more than a quarter of a mile from a station. In the residential district the fire halls are one mile apart, placing each residence within a half mile of a station.

There is a direct line from the switch-

ORNAMENTAL *standard to which are attached both Police and Fire Alarm Boxes.*

board in the waterworks, enabling the operator to request an increase in water pressure if necessary.

Of scarcely less importance is the position of the police switchboard operator. Tho his acquaintance with the city must not necessarily be so thoro as that of the fire operator, there is an equal demand for a cool-headed man who thinks and acts promptly.

HOW REPORTS *are* RECORDED.

His switchboard is a complicated affair, especially designed by Chief Bideker and Superintendent Smith.

The police boxes are arranged on six circuits. As a policeman opens a box and phones once an hour, according to regulations, a recording register rolls out a paper tape with the time, date, year and number of the box stamped upon it. The policeman at the same time telephones his report. This is recorded on a large sheet, together with the memoranda taken from the tape and kept on the operator's desk where it may be referred to at a moment's notice.

There are three other calls from police boxes which the tape records. They are slow patrol, fast patrol, synonymous to the riot call in other cities, and the ambulance call. The position and number of the punch-marks upon the tape indicate the nature of the call.

I value very highly the feature of the Fort Worth system whereby the lamp fixture carries the alarm box on the side of the standard, or upright, of the fixture, with the globe at the top, illuminated all of the night and banded with red that may be seen afar off, and the terminal board in the base of the lamp fixture.

The object of the terminal board in the base of the lamp fixture is to eliminate cable splicing in manholes. This terminal board does away with all cable splicing and consequent possibility of troubles from leaky splices in the manholes. Another advantage is that the entire cable is at your service without opening up the manholes. This facilitates picking up a new wire in event of accident, lightning or other things, breaking a wire.

DES MOINES has pointed the way to the solution of many problems which have been troublesome to cities of all sizes. Des Moines is a leader among cities. The steps it has taken to abolish the smoke nuisance have been active and aggressive—they have accomplished something—in marked contrast to the usual campaign against smoke which dies in the committee rooms of the commercial club. The illustration shows typical conditions in Des Moines before action was taken.

FIGHTING THE SMOKE NUISANCE

By HARRY McNUTT. *Smoke Inspector, Des Moines, Ia.*

THE organization of the smoke department of the city of Des Moines consists of the smoke inspector and the smoke abatement commission of five members, whose policy has been one of education among the plant owners and operators rather than one of rigid prosecution for violations. The plan had been to give all the engineers and firemen instructions how to avoid smoke, and to allow the owners of plants plenty of time to make any alterations in their equipment which might be needed to make possible the smokeless operation of their plants. It soon developed that the results from the policy did not justify its continuance. The plant owners were not meeting the department half way in the matter, and the plants continued smoking all the time, practically no efforts being made to avoid the smoke.

During the winter of 1911 a few plant owners co-operated with the department in a commendable manner and installed smokeless firebox boilers. The results obtained in these instances were so successful that they effectually met the argument advanced frequently by the violators, i. e., that it was impossible to avoid smoke with Iowa coal.

When the spring of 1913 arrived it was decided by the superintendent of the department of public safety and the writer that it was time for a more strict enforcement of the provisions of the ordinance. Suits were begun against those who had shown no disposition to make improvements, and almost immediately signs of decided interest were noticed. Many improvements were made and a number of the worst offending chimneys were cleaned up. The results obtained from the change in policy encouraged the writer to be even more strict. Suits and fines had a very good effect upon violators, who, realizing that the department was in earnest, began to fix up their plants to eliminate the smoke. Several defendants in the suits in which action was started in police court, resulting in fines of $10.00 and costs, carried their cases to the district court, where the prosecution was sustained and the amount of fines increased to $25.00 and costs. Conservatively speaking, there is at least 30 per cent. less smoke in the city of Des Moines at the present time than a year ago.

The reasons for the difficulty in obtaining high economy from the bituminous

coals when hand-fired in ordinary furnaces may perhaps be understood if we consider the sequence of events that take place between two consecutive firings 5 to 10 minutes apart.

THE *waste of heat units due to the imperfect combustion, which produces an excess of smoke, is sufficient to demand the attention of plant owners, regardless of the nuisance itself.*

Suppose that just before firing fresh coal an intensely hot bed of coke, 6 inches deep, is lying on the grate bars. Several shovels of coal, much of it fine in size, are spread evenly over the bed. The first thing the fine coal does is to choke the air spaces existing in the bed of coke, thus shutting off the air supply which is needed to burn the gases produced from the fresh coal. The next thing is a very rapid evaporating of moisture from the coal, a chilling process, which reduces the temperature of the furnace. Next is the formation of water gas by the chemical reaction, the steam being decomposed, its oxygen burning the carbon of the coal to carbonic oxide, and the hydrogen being liberated. This reaction takes place when the steam is brought into contact with highly heated carbon; this also is a chilling process, absorbing the heat from the furnace. The two valuable fuel gases thus generated would give back all the heat absorbed in their formation if they would be burned completely, but there is not enough air in the furnace to burn them. Admitting extra air through the fire-door at this time will be of little service, for the gas, being comparatively cool, cannot be burned unless the air is highly heated. After all the moisture has been driven off from the coal the distillation of the hydro-carbons begins, and a considerable portion of them escapes unburned, owing to the deficiency of heated air and to their being chilled by the relatively cool heating surfaces of the boiler. During all this time great volumes of smoke are escaping from the chimney, together with unburned hydrogen, hydro-carbons and carbon monoxide, all fuel gases, while at the same time soot is being deposited on the heating surface, diminishing its efficiency in transmitting the heat to water. At length the distillation of the hydro-carbons proceeds at a slower rate, the very fine coal which first obstructed the air supply is partially burned away, sufficient hot air comes through the bed of hot coke to burn thoroughly all the gases, and such a balance of conditions between the amount of gas generated and the amount of air supplied exists that good economy is obtained. As soon as the fuel burns down low, and the air spaces become large enough to allow an excessive supply of air into the furnace, a new condition of poor economy is reached, the excess of air passing up the stack carrying away heat which should have been utilized in the boiler.

The waste of fuel is not the only loss occasioned by the prevalent wrongful method of burning coal, but there is the depreciation in value of residence property in the vicinity of factories, the cost of painting and repainting houses and stores, the destruction of textile fabrics, etc.

BY CORRECTING *the cause of incomplete combustion in the furnace and by proper firing, the smoky chimney can be eliminated.*

Bituminous coal is made up of fixed carbon, volatile matter (mostly combinations of hydro-carbons), ash and moisture. The amount or percentage of volatile combustible in the coal is the chief determining factor so far as smoke is concerned. Ordinarily speaking, a coal with a high volatile percentage (35 to 45 per cent.) will require special equipment in order to be burned without smoke.

The amounts of ash, moisture and sulphur also enter into the problem indirectly, as affecting the requirements for grate surface, draft and means of cleaning fires, etc., but the amount of volatile hydro-carbons in the fuel is the main factor to contend with.

Of course, we must bear in mind always the single fact, which too frequently is not recognized, that smoke is not a product of the combustion of coal, but is the result of incomplete combustion, and that

when bituminous coal is burned so that the burning is complete there is no smoke produced and the heat units developed are correspondingly greater than when for some reason or other the process of combustion is so interfered with that part of the gases pass off unburned, some of them passing off in the form of smoke.

Obviously the only sensible way to solve the problem of the smoking chimney is to correct the cause of the smoke by producing as nearly as possible complete combustion of the fuel, or, to be more exact, of the volatile hydro-carbons, for the fixed carbon does not form smoke under the most unfavorable conditions.

In order to obtain perfect combustion of the hydro-carbon gases there are three things necessary:

First. The gases must be heated to their ignition point and that temperature must be maintained during the process of combustion. In practice this temperature is from 2,000 to 2,800 degrees Fahrenheit. Second. There must be sufficient air to combine with all the gases. Third. The gases and air must be thoroly mixed together at the temperature mentioned above. If these conditions are met there will be no smoke, but care must be taken to prevent a large excess of air, or there will be a loss due to that fact.

The practical way to provide and maintain the required temperature is by means of some form of fire brick furnace or arch, which will keep the burning gas from coming in contact with the heating surface of the boiler until combustion has been completed. The extent of fire brick work depends in a large measure upon how nearly correct provision is made for the other two essentials, sufficient air and proper mixture, and these two must really be considered as one.

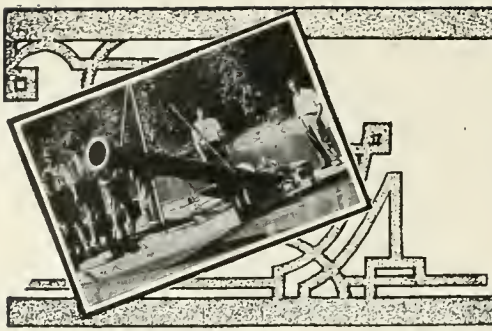
From June 1, 1912, to March 1, 1913, our records show that a large number of Kewanee smokeless firebox boilers have been installed and it is but fair to state that these installations are a great help in our fight for the elimination of the smoke nuisance in Des Moines. These boilers are set in brick and the travel of the hot gases is thru the fire tubes, then completely around the outside of the boiler before they enter the breeching. This long travel of the hot gases makes is possible for the water in the boiler to absorb all of the heat, which is practical. Tests have proven that in Kewanee boilers the gases enter the breeching at about 225 degrees. Other tests have shown that in many other boilers the hot gases enter the breeching at from 400 to 600 degrees and sometimes higher.

The following report of the smoke department from June 1, 1912, to March 1, 1913, may be of interest:

Total number furnace changes	219
Contracts let for remodeling plants	16
No. stack readings taken	250
No. letters written to plant owners	753
No. letters received from plant owners	182
No. cases pending in court	10
No. cases dismissed in court	17
No. cases appealed to district court	12
No. cases fined in police court	14
No. cases dismissed on promise to remodel plants	17
No. cases settled out of court	112
No. cases pending in district court	2

Des Moines has 600 smokestacks which come directly under the supervision of the smoke department. Out of this number 225 are high pressure plants, the balance low pressure.

SAND *piles for the little tots in the public playgrounds and parks of various cities are as important as the ball grounds and athletic fields for the older children. The illustration shows a sand pile in one of the parks of Minneapolis.*



EDITORIAL

WE GET WHAT WE DESERVE

The investigator of city governments and their results ultimately arrives at two conclusions which may seem to be contradictory, but they are both logical results of observed facts and simply state two phases of the general principle that the city enjoys the kind of government which its citizens desire.

On the one side it may be shown by a number of examples that the results of city government are independent of its form. Thus one city seems to have no central authority beyond that of the city council over appropriations and some appointments, but the results of its government are excellent from almost every point of view. Its construction department is obtaining the best of results in paving, sewerage and sewage disposal, bridges and viaducts. Its water department, while handicapped by insufficient appropriations, is kept in the best possible condition. Its police department is doing wonders in cleaning up vicious conditions, even against the opposition, tho not active and open, of the mayor. Its fire department has a low record of disastrous fires, tho it does not have modern apparatus. But in each department the citizens are behind the movements which are made and they are getting what they want. And they seem to know how and why, altho the city publishes no annual reports.

Another city has a commission which has almost absolute power over improvements. It does good work in paving and sewers, it has an up-to-date fire department, it has low taxes, but it seems to lack the vigor of the other city. The reason for it is that the citizens are not so anxious for improvement and prefer a slower rate of progress, with lower tax rate, and the commission, notwithstanding its large powers, is very willing to follow the desires of its constituents.

The difference between the two cities lies in the temper of the citizens rather than in the form of government.

On the other side, it may be shown by a number of comparisons between the government of cities before and after changes in form, that the form of government has much to do with the rate of progress of the city.

The real reason for the advancement is, however, the change in the expression of the desires of the citizens. Under the former system a few objectors were able to delay improvements, while neighboring cities,

objectors were able to delay improvements, either in construction or in administration, and the citizens could not obtain what they wanted without greater effort than they were willing to put forth. Neighboring cities whose citizens were alive to the possibilities worked to get what they wanted in spite of the handicaps of the law, and they got it. The change in form made it easier for the progressive citizens to get what they wanted, provided they were in the majority, and therefore the change in form of government resulted in improvement. In a few cases the reactionaries are really in the majority, and in those cities the rate of progress is not kept up.

The two statements are not so contradictory as they may seem at first sight, and it is undoubtedly true that the citizens get the kind of government they deserve, whether or not it is the kind they would like to have. If they want good government they will get it if they try for it. If they only "like to have" good government, they get what the people in control give them.

The improvement in form of government makes it easier for the more progressive element to secure control, but it still requires effort.

The same reasoning applies to honest government, as the grafting politician finds it easier to manipulate under a government without system if his supporters are in the minority, but he finds it still easier to operate under a thoroly systematized and centralized form of government if his supporters are in the majority. So here, again, the citizens can protect themselves under either form, if they will take the trouble, and they are robbed, by retail or by wholesale, if they do not take sufficient interest in the character of their candidates for office.

FRANCHISE CONTRACT INTERPRETED FOR THE CITY

The modern idea that a contract with a public service corporation should be interpreted in case of doubt in favor of the public is again emphasized in the decision in the Denver case that the city need not extend the franchise nor buy the works under its terms unless it can secure equitable terms, all things considered. This relieves the present public of the burdens sought to be placed on it under forced interpretations of the terms of the contract and makes it possible for the city to obtain a water supply at the cost of construction of a new plant of the same quality and capacity. This decision is a step in advance which has been anticipated for some time and clears the way for others to follow.

This is not an argument against improvement of the form of government, because it is certainly easier to secure good government under a proper system, but it is a demonstration from existing facts that the citizens can secure the government they want, if they want it strongly enough, no matter what particular form they may be operating under.

QUESTION DEPARTMENT

Ordinance Regulating Weighmaster

I shall be obliged if you will send me, a copy of an ordinance establishing city scales and regulating the weighing of coal and other commodities which are sold to the public, and providing for the issuance of certificates of the weigh-master, etc., to the party purchasing the commodity, suitable for city of about 5,000.

B., City Attorney, ———, N. M.

Following is an ordinance governing city weighmasters:

"There shall be an officer in and for the city of ..... to he known as weighmaster of the Eastern District, and also an officer to be known as weighmaster of the Western District. Said officers shall be appointed by the Board of Aldermen on the second Tuesday of June in each year, or at auy other subsequent regular session of the Board of Aldermen, and shall hold office for one year from and after the first day of July and until their successors are appointed and quallfied, and each receive such annual salary as the Common Council shall prescribe.

The weighmasters, before entering upon the duties of their respective offices, shall execute a bond with one or more sureties to the City of ..... in the penal sum of $5,000, conditioned as prescribed in the city charter, and shall also subscribe the oath of office prescribed therein. It shall be the duty of the weighmaster to weigh any hay, coal or straw which may be brought to the public scales uuder his charge, and after deducting the weight of the cart, wagon or sled, he shall deliver to the owner the certificate hereinafter provided. He shall demand and is authorized to collect from the person in charge as a market fee for each load of hay brought upon the market grounds drawn by two animals the sum of 30 cents, and for each load of straw, and for each load of hay drawn by one animal the sum of 20 cents, and for each load of coal the sum of 10 cents, the payment of which said market fee shall be in lieu of all other charges and shall entitle the person paying the same to the privileges of the scales. It shall be the duty of each weighmaster to be in attendance at his office from 7 o'clock on the morning until 7 o'clock in the evening of each day.

Persons owning or having in charge carts, wagons or sleds, loaded with hay or straw, shall not permit the same to stand in any street, avenue, alley or public space, but all such vehicles shall stand at or adjoining the public hay scales in such order as shall be prescribed by the weighmaster.

This ordinance shall not apply to straw made up into and sold by the bundle.

The weighmaster shall designate the places in the public wood yards where animals may be exposed for sale, and all persons owning or having animals in charge shall strictly comply with the rules and regulations prescribed by the weighmaster for the good order and government of their respective yards.

The weighmaster shall be entitled to demand and receive from the owner or person for whom he weighs any horse or meat cattle, the sum of 10 cents per head; and for any sheep or hogs, the sum of 5 cents per head.

The controller shall furnish each weighmaster with a book containing blank certificates printed in duplicate form, which certificate s shall be numbered and stamped by the controller. And it is hereby made the duty of the weighmaster upon weighing any hay, straw, coal, or other commodity or any animal, to deliver to the owner or persons in charge thereof one of such duplicate certificates, to be an exact copy of the certificate retained in the book. Such certificates shall show the name and place of residence of the purchaser and seller, the kind or nature of the commodity or thing sold, the gross and net weights, the amount of fees paid, and shall be signed by the weighmaster delivering same: Provided, that while any commodity or thing is brought upon the ground but not weighed the

certificate shall be required to show the name of the seller and purchaser, when the same can be ascertained, and the nature of the commodity or thing, and whether the vehicle is drawn by one or two animals.

It shall be the duty of each weighmaster to pay into the city treasury on Monday of each week all money received by him in the pursuance of his duties for the previous week, receiving in return from the treasurer a proper receipt for the amount thereof, countersigned by the controller; and also at the same time to report to the controller under oath a detailed statement showing the sources from which such moneys were received. The books kept by weighmasters shall be open at all times to the inspection of the controller, city accountant or any committee of the city council authorized by resolution to inspect the same.

Any weighmaster who shall be guilty of taking or demanding more fees than are prescribed by this ordinance, or who shall be guilty of any fraud or peculation in his office shall in addition to the punishment hereinafter prescribed be removed from office by the Common Council of .....

Any violation or failure to comply with the provisions of this ordinance shall be punished by a fine not to exceed $100 and costs; and in the imposition of any such fine and costs the court may make a further sentence that the offender shall be committed to the county jail or city house of correction until the same be paid, for any period of time not exceeding 6 months."

There may also be an ordinance providing for an inspector of weights and measures, whose duty it would be to test all weights and measures used in the sale or purchase of goods of any sort by private persons within the city.

Septic Tank Patent Decision—Sewage or Water Purification

Where will I find the case in which the United States District and Circuit Courts of New York decided that the sewage disposal plant constructed by the city of Saratoga was an infringement on the Cameron patent? What leading engineers take the position that the purification of sewage so as to render the same pure when turned into the stream is impracticable and a fallacy, and hold that the proper thing to do is to so dilute the sewage as to prevent nuisance in the stream and treat and purify the water of such streams before using, and where could I find the leading article or report taking this view? W., Butler, Pa.

The decision on the Cameron Patent in the Saratoga case is in vol. 159 of the Federal reports, pages 453-464. The matter has been discussed in MUNICIPAL ENGINEERING in several numbers. In vol. xl, p. 1, is an article on "Sewage Disposal of Atlanta, Ga." which gives the position of the Cameron Septic Tank Company with reference to the use of the Imhoff tanks in Atlanta, Ga. On p. 219 will be found some references also. In vol. xxxix, p. 238, is a statement from the company in an article headed "Cameron Septic Tank Patents," which gives the position of the company. On p. 349 are some statements of the principle of the Cameron invention in an article on "The Present Use of the Septic Tank," and on p. 39 is another article referring to previous articles. In vol. xxxviii, p. 192, is still another article giving references to previous articles on the Cameron litigation. In vol. xxxvi, p. 241, is a full list of previous articles on the septic tank which includes a number on the Cameron tank. In vol. xxxv, p. 288, is an article on "Septic Tank Patents" which gives an outline of the patents on the septic tank and also the decision of the U. S. Circuit Court of Appeals on the Saratoga case. On p. 311, is an editorial based on the last named article. In vol. xxxiv, p. 94, is also another editorial. On p. 107 is an abstract of the decision and on p. 303 is a letter and editorial discussion of the same which has for its basis the decision. In vol. xxxii, p. 42, is an article entitled "Explosion of the Saratoga Septic Tank," which may have a passing interest.

Practically all leading sanitary engineers take the position that the purification of sewage so as to render the same perfectly pure at all times when turned into the stream, is impossible. But most, if not all of them, hold that the sewage, if discharged in any considerable volume, must be purified before discharged into a stream in order to prevent nuisance in case the stream is small and in order to render the water of the stream as nearly innocuous as possible, especially if it is to be used below the sewer outlet as a source of water supply for a city or town. In case such water supply is drawn from the stream within a comparatively short distance of the sewer outlet, it is becoming more necessary each year, in the opinion of engineers, to disinfect and purify the sewage in order to remove any possibility of danger to the water supply.

The most advanced sanitary engineers are contending for the purification of a water supply drawn from a stream whether that stream is polluted by a sewer directly or not. The present law on this subject for the State of Indiana was based on the principle that the pollution of a stream should be kept as low as possible by purification of the sewage and the safety of the water supply should be insured as nearly as possible by the purification of the water supply. The

State Board of Health was given the power to order the correction of objectionable conditions and a method was provided for determining who should pay the expense of such corrections, whether the city discharging the sewage or the city using the water supply, or both, or any private parties interested on either side.

During the early discussions of this subject there were some articles which took the position that the proper thing to do is to so dilute the sewage as to prevent nuisance in the stream and to purify the water of such stream before using, but this is often impossible and the word "treat" should be substituted in place of the word "dilute," meaning by that word such partial purification of sewage as amounts to dilution, and at the same time the removal of a large part, or all, of the bacteria and other dangerous constituents or inhabitants of sewage.

Ordinance Governing Billiard Rooms

I enclose herewith a copy of ordinance No. 262 o fthe city of South Pasadena. This ordinance has been passed upon by the courts of California and by the Supreme Court of the United States, and, therefore, its legality is thoroughly established. I though that you might be interested in knowing of such legislation and the constitutionality of the same. I a mcity attorney of the city that passed the ordinance.

JOHN E. CARSON,
Los Angeles, Cal.

An ordinance for police regulation, relating to billiards halls, pool rooms, and places where billiard, pool, or combination billiard and pool tables are kept for hire or public use in the city of South Pasadena.

The Board of Trustees of the city of South Pasadena do ordain as follows:

Section 1. It shall be, and is hereby made unlawful for any person or persons, individually or by association with others, either as owner, principal, clerk, agent, servant or employe to establish, open, keep, carry on, or assist in carrying on, or maintain, or assist in maintaining any billiard hall, or pool room, or other place in the city of South Pasadena, where any billiard, pool, or combination billiard and pool table, or tables, is or are kept for hire or public use, and any person or persons, opening, keeping, carrying on, or assisting in carrying on, maintaining, or assisting in maintaining, any such place, herein specified, in said city of South Pasadena, shall be guilty of a misdemeanor, and every act in violation of this section shall separately, or for each day of its continuance, be deemed a separate offense.

Provided, however, that nothing in this ordinance shall be construed or understood as prohibiting the owner, manager, or lessee of any hotel, universally recognized as a hotel, using a general register for guests, and having twenty-five bedrooms and upwards, furnished as such, from keeping and maintaining any billiard, pool or combination billiard and pool table, or tables for the use of regular guests only of said hotel, in a room provided for that purpose in the building in which said hotel is located, and at no other place, on receiving a permit so to do, from the Board of Trustees of the city of South Pasadena. Applications for such permits shall be in writing, and filed with the Board of Trustees at least five days before the same is granted. If on investigation said Board finds the hotel for which such permit is desired, equipped and conducted as herein specified, it may, in its discretion, grant and issue such permit, without charge, and for such time as desired by the applicant, but in no event to extend beyond the date of the next succeeding municipal election; provided, if said Board of Trustees shall at any time become satisfied that any person to whom any such permit is granted, his clerk, agent or employe has permitted any person other than a regular guest of said hotel, or any person who has not in good faith become a regular guest of said hotel or is guilty of a violation of any provision of this ordinance, they shall cancel, revoke and withdraw such permit and all rights thereunder, and no other permit shall thereafter be granted to said person.

Section 2. Any clerk, servant, agent, employe, or person committing any act in violation of any of the provisions of this ordinance shall be deemed guilty as principal.

Section 3. Every person taking out or having taken out a license for any business for which a license is required by the city of South Pasadena, who shall be convicted of establishing, keeping, or maintaining a place where any billiard, pool or combination billiard and pool table, or tables is or are kept contrary to the provisions of this ordinance, shall, in cases where such unlawful place has been established, kept or maintained, or said unlawful act has been done in connection with said lawful business, forfeit such license and no new license for such lawful business shall be issued to said person during a period of one year thereafter.

Section 4. Every person found guilty of a violation of any of the provisions of this ordinance shall be fined in the sum of not less than $25 nor more than $300, or shall be imprisoned in the city jail of the city of South Pasadena, or in the coun-

ty jail of the county of Los Angeles, for not more than three months, or by both such fine and imprisonment, and every judgment of fine for violation of any of the provisions of this ordinance shall direct that in default of payment of such fine, or any part thereof, the person shall be imprisoned in the city jail of the city of South Pasadena, or in the county jail of the county of Los Angeles, until the fine is satisfied, in the proportion of one day's imprisonment for every $2.00 of such fine remaining unpaid.

Payment of Costs of Proceedings in Special Assessment Improvements

Under our present laws in regard to special assessment work, are municipalities limited to 6 per cent. of the estimated cost of any special assessment improvement, or would it be legitimate to set aside other moneys above this amount to pay for court costs, advertising, inspecting and engineering, attorney's fees, etc.? What is the practice being followed in villages and cities in this regard?

In many instances it appears that 6 per cent. is not sufficient to cover these expenses. Especially is this true when a contest is made, and I am informed that many municipalities are using funds in excess of 6 per cent. Do they lay themselves liable by such action?

FOR INFORMATION, ———, Ill.

The provision in the law which is referred to is doubtless the following passed in 1901:

"The cost and expenses of maintaining the board of local improvements herein authorized, of paying the salaries of the members of said board, and the expense of making and levying special assessments or special taxes and of letting and executing contracts; and also the entire cost and expense attending the making and return of the assessment rolls and the necessary estimates, examinations, advertisements, etc., etc., connected with the proceedings herein provided for, including the court costs, including the fees to commissioners in condemnation proceedings, which are to be taxed as above provided, shall be paid by the city, village or town out of its general fund: Provided, however, That in cities, towns or villages of this state having a population of less than 100,000 by the last preceding census of the United States, or of this state, the city, village or town, as the case may be, may in and by the ordinance providing for the assessment prescribed, provide that a certain sum, not to exceed 6 per centum of the amount of such assessment, shall be applied toward the payment of the aforesaid, and other costs of making and collecting such assessment."

The proviso was held in 1907 to be valid in the case of N. W. Univ. v. Wilmette, 230 Ill. 80.

This section very definitely provides that the costs of the proceedings, as enumerated, shall be paid by the municipality unless the ordinance ordering the improvement provides that a part shall be paid by the property owners, in which case a sum, not to exceed 6 per cent. of the assessment levied, shall be applied toward the payment of the costs of the proceeding. It is evident that any excess of such costs of proceedings above the 6 per cent. must be paid out of the general fund of the municipality. There is no restriction in the section upon the total amount of these costs.

Wooden Water Supply Main

This city has two miles of water main flow lines to lay. A certain manufacturer of our city suggested the laying of 16-inch wood pipe, instead of cast iron pipe, and stated that other cities have installed them with success, at a cost approximately one-half the cost of cast iron.

This proposition does not look good to me, nor have I ever heard of cities using wood mains outside of New Orleans, which were installed many years ago. In fact, before cast iron pipe were much in use. Will you kindly give us your opinion from an engineer's standpoint as to the advisability of using these wood mains, and also state what cities are using them successfully

M., Mayor, ———, Neb.

Wood stave pipe is used in many cities for supply mains where there are but few taps. There are safe methods of tapping wooden water pipe but this material is not so popular for distribution pipes as it is for supply mains, partly, of course, because it is not so suitable for the smaller sizes of distribution mains. Wood stave pipe is also used for supply lines for irrigation purposes.

In MUNICIPAL ENGINEERING, vol. xliii, p. 29, will be found a description of the wood-stave force main in the water works of Atlantic City, N. J., which replaced a steel force main which, on account of the peculiar conditions, was badly pitted by chemical action. Similar action was noted on cast-iron mains. Pipe in use at Walla Walla, Wash., and near Basin, Wyo., is shown in vol. xxxix, p. 13; at Ogden, Utah, in vol. xxxviii; at Astoria, Ore., in vol. xxxvi, p. 15; by Bear Valley Irrigation Co., vol. xxxiii, p. 112; at Denver, Colo., in vol. xxxi, p. 135. Cost data are given in vol. xxxi, p. 21, vol. xxiv, pp. 279, 365.

Full discussions of the proper construction and use of wood stave pipe for supply mains will be found in the transactions of the American Society of Civil Engineers, vols. vi, xxxi, xxxiii, xxxvi, xxxviii, xl, xli, xliv, xlix, lviii, lxx, lxxiv. They all show that properly designed and constructed supply mains made with the proper materials are durable and eminently satisfactory.

Among the cities using wood pipe are

San Francisco, Los Angeles, West Los Angeles, Bear Valley, Hollister, San Diego, Floriston, Bakersfield, Cal.; Cheyenne, Wyo., Ogden, Provo, Logan, Utah, Denver, Colo., Caldwell, Idaho, Butte, Mont., Astoria, Ore., St. Paul, Minn., Atlantic City, E. I. Dupont Powder Co., Carneys Point, N. J., Seattle, Wash., DePere, Wis., E. P. & S. W. Ry., Santa Rosa, N. M. The sizes used run from 12-inch diameter to 72 inch.

As to cost, no definite figures can be given without knowledge of the local conditions. The discussions of cost referred to above, indicate that the wood stave pipe is in some localities materially cheaper than cast iron and steel, but in others the cost is very nearly equal. The size of pipe to be used has a large influence upon the comparative cost of wood and iron.

Water Rates in Kentucky

We are in search of information in regard to the prevailing rates charged for service in waterworks plants in the state of Kentucky, and also as to the usual rates charged under contract for fire service, and would appreciate it very much if you would advise us as to where we might obtain this information.

W., ———, Mich.

Full water rate schedules are given in the Manual of American Water Works ($1.50). The last edition of this book was published in 1897 so that it is quite old, but water rates do not change very often so it is probably still very fairly representative of them. A considerable collection of water rates, especially in cities, is given in a paper by Dow R. Gwinn, who is this year the president of the American Water Works Association, which he presented to that association four or five years ago. It can be obtained from the secretary, J. M. Diven, 47 State street, Troy, New York, for about $1.00. MUNICIPAL ENGINEERING has published a number of collections of water rates which may aid.

Water rates in Kentucky range between the following limits:

Family rate based on family of 5 in an 8-room house with faucet in kitchen or yard, hot water faucet included if allowed, from $3.50 to $12 a year, the most popular rate being $8.

Water closets, $2 to $6, with $4 the most common.

Bath tub, $2.50 to $6, with $4 the most common.

Wash bowl, 0 to $5, with 0, $1 and $2 equally popular.

Horse and carriage, $1.50 to $8, with rates from $4 to $5 most common.

Hose, $4 to $13.

Meter rates range from 10 to 50 cents per 1,000 gallons for the maximum rate, with 25 and 35 cents as the most popular; 7 to 16 cents minimum, with 10 cents as the popular rate. Several cities have the sliding scale with diminishing rates for additional quantities beyond the various limits set. The maximum rates apply in most cities to consumption less than 1,000 gallons a day.

Clearance for Overhead Crossings

I desire to obtain some information regarding the clearance allowed between steam railway tracks and overhead bridges in the different parts of the United States. The minimum clearance allowed by law in Canada is 22 feet 6 inches.

A. J. LATORNELL, City Engineer,
Edmonton, Alberta.

Where the roadway passes over the railroad the minimum clearance from top of rail to base of lowest girder of overhead bridge is 22 feet in Illinois and Vermont unless the clearance is not practicable; is 21 feet without exception in Indiana and New Hampshire; 21 feet in Ohio, reducible to 16.25 feet by agreement; 18 feet in Connecticut, Massachusetts and Rhode Island; 21 feet where practicable and not less than 18 feet in New York. In the electrical zone on the New York Central and New Haven roads this is reduced somewhat. The Pennsylvania railroad has used 16.5 to 18.5 feet and considers 21 feet as the maximum necessary. This allows 14 feet for car height and 7 feet for man standing on the top of car. The Grand Trunk tunnel at Port Huron has a clearance of 14 feet at a point 3 feet from the center line, Minneapolis, Minn., uses 22 feet.

Where the railroad passes over the roadway the clearance is less, running from 12 to 15.75 feet in plans for track elevation in Indianapolis, Ind., the latter height being for interurban cars running on the street; 13 to 14.5 feet in past work in Cleveland, O., which will probably be increased to 15 feet whenever possible; 14.5 to 20 feet in Pittsburg, Pa.

Removal of Snow by Street Railways

The councils of this city are desirous of enacting an ordinance which will require traction companies to take care of or remove in some manner or degree snow on that part of a street occupied by the tracks and roadbed of the companies, and I thought possibly you could refer me to an ordinance of similar kind which has proved satisfactory in some other city.

A. A., City Solicitor,
Chester, Pa.

The provision for removing snow from street railway tracks is usually, if not always included in the ordinance granting the street railway a franchise.

In MUNICIPAL ENGINEERING, vol. xli, p.

34, is an article giving the provisions in various franchises of this sort in Elgin and Moline, Ill., Hammond, Ind., Dayton, Ohio, and Rome, N. Y. If the street railway franchise contains no such provisions the matter can probably be taken care of by an ordinance passed under the police powers of the city. The Dayton ordinance is the most specific, but covers the cleaning and sprinkling of the tracks without special reference to the snow, but the ordinance can easily be modified to cover snow removal.

Private Ownership of Sewer System

Can you advise me of any case of private ownership of sewer systems for small towns in which the privilege to connect is made a matter of special charge. If you do know of such cases I will thank you for any information telling me of the degree of success such a plan has made.

A. C. F. Norfolk, Va.

This subject has been discussed from various points of view in several articles in MUNICIPAL ENGINEERING, the general conclusion being that a private sewer system is a last resort when there is no other way of securing the service.

Rates are given in an article in vol. xxxix, p. 40, which refers to more detailed descriptions of methods given in still earlier articles, and names of a number of cities having such private sewer systems are given. There is a strong tendency first for the city to assume payment of all rentals and, second, to assume the whole system either by direct payment or by having rentals apply on purchase. Following is a list including some of each class: Telluride, Colo., Vincennes, Ind., Newton, Kan., Sheveport, La., Natchez, Miss., Columbus, Neb., Asbury Park, N. J., Atlantic City, N. J., Toronto, O., McKinney, Tex. Ellsworth, Kan., is reported in vol. xliii, p. 119, to rent its sewer system.

A list of nearly 50 cities with privately owned sewer systems is given in the "Municipal Year Book" published in 1902, by nearly all of these have passed to municipal ownership.

How to Test Asphalt

Will you please inform me where I may secure detailed directions for testing asphalt and asphaltic cement?

W., City Engineer, ———, Mich.

The tests of asphalts for paving purposes recommended by Dow and Smith are given in MUNICIPAL ENGINEERING, vol. xl, p. 437; standard tests for asphaltic cements for sheet asphalt pavements, by J. W. Howard in vol. xli, p. 342; methods of testing coal tars and refined tars, oils and pitches derived therefrom, by S. R. Church, in vol. xl, p. 417; standard tests for bituminous road materials, by L. W. Page, in vol. xli, p. 110. The standard specifications for asphalt pavements adopted by the American Society for Municipal Improvements, including methods of testing the materials are published in pamphlet form by the society and those of the society for Standardizing Paving Specifications can be obtained for $5. Both can be obtained from this office.

Form of Electric Light Franchise

Will you please send me what information you have in reference to ordinance granting franchises to electric light companies or to parties for the purpose of building an electric light plant in a city of about 2,000. Copies of ordinances in reference thereto we will be pleased to receive.

C. A., City Attorney, ———, Kan.

A form of ordinance which includes some provisions regarding methods of future determination of rates when conditions change from those at present existing, on account of the growth of the city or otherwise, will be found in MUNICIPAL ENGINEERING, vol, xliii, p. 322. The city in which this ordinance is in force has about 5,000 population. The ordinance contains the usual provisions requiring good service to city and to private consumers, assuming by company of consequences of damage from construction or operation, requiring permits for extensions, street openings, etc., providing bonds for carrying out terms of contract, etc., and also provides for the appointment of a board of experts to determine what the rates for service shall be in case either party thinks they should be changed and it is not possible to agree upon such rates; and provides that a rate when fixed shall stand for five years before it can again be questioned.

Specifications for Wood Paving for Bridge

Will you please send me information for writing specifications for paving roadway of iron bridge with creosoted wood block? Bridge is 85 feet long, 14-foot roadway.

P., City Engineer, ———, Pa.

In vol. xlii of MUNICIPAL ENGINEERING, pp. 389 and 472, will be found two articles on "Floor for Highway Bridge," which give data on which to base specifications. In vol. xli. p. 294, in an article on "Expansion and Contraction in Wood Block Pavements," is a rather detailed specification for laying a bridge floor. Specifications for wood block treatment and for laying pavements are discussed in many other articles, some of which may be of use in this case.

WORKERS IN THE FIELD

Nelson Street Viaduct, Atlanta, Ga.

The old viaduct which carried Nelson street, Atlanta, Ga., over the yards of the Southern Railway has just been replaced by a modern reinforced concrete arch roadway which has proved to be a most happy combination of strength, utility, and beauty.

The viaduct starts from a concrete abutment at the property line of Madison avenue and rises gradually for a distance of approximately 355 feet at the rate of 2 feet in 100 to a point over the middle of the main line tracks, from which it drops for 125 feet at the same rate to an abutment at the Elliott street end. The total length from abutment to abutment is 479 feet 4½ inches.

The structure is made up of ten arches varying in span from 20 to 75 feet. The entire width is 50 feet. Of this width 32 feet is used as a roadway on each side of which is a sidewalk 9 feet wide. The clear headroom under the arches over the main tracks is 21 feet and over the tracks of the freight yard is 18 feet.

The arched rib type of viaduct was adopted, the reinforcement being Kahn trussed bars. The same reinforcement was used in the abutments, footings, posts, and the slab supporting both the roadway and the sidewalks. There are six ribs supporting each span, four spaced 5 feet on centers coming under the street car tracks and one under the curb line on each side. The reinforcement is placed in both the intrados and extrados with the diagonal members of the Kahn bars bent away from the main bar at an angle of 45 degrees and allowed to project well into the concrete ribs. The bars are made of such length and so arranged as to give the effect of a latticed girder. The particular advantage obtained by this form of reinforcement is that the members entering into the ribs are rigidly attached to the main reinforcing member and greater stiffness and stability result.

The ribs are designed to support the following loads: Dead loads, concrete 140 pounds per cubic foot and the road material 100 pounds per cubic foot; live loads, 100 pounds per square foot on walk, 100 pounds per square foot or a 15-ton moving road-roller on the roadway, and a succession of 40-ton electric cars on the track ribs. The sidewalks on each side are carried by brackets which are cantilevered from the outside ribs a distance of 9 feet. The sidewalk-slab spans between these brackets, and the concrete railing is carried at the outside edge of the slab.

The lines of the structure are extremely simple and pleasing and convey to the eye at once the impression of strength. The arrangement of ribs, cantilever brackets, posts, and arches looks reasonable even to one unfamiliar with engineering design.

CAREFUL *reinforcing has produced a structure continuous in all its members, free from cracks, economical in construction and pleasing to the eye.*

All of the floor construction is made continuous over ribs and the ribs are made continuous thru their supports. In fact all members are completely tied together with Kahn trussed bars so as to insure continuity and also to prevent any cracks due to shrinkage, temperature changes, negative bending moments, etc. So carefully has this principle been worked out that even where the amount of concrete used is very small there has not appeared in the whole structure the slightest crack. The structure is an excellent example of how ingenuity of design and arrangement of members, as well as proper reinforcement and its distribution, can produce an economical as well as strong design. It is not necessary, in order to keep the cost down, to skin or reduce the material. A little ingenuity in the design and arrangement of members more than offsets any advantage of economy that might be obtained by such dangerous practices.

The beauty of the structure is remarkable. Graceful curves and outlines are obtained with no extra cost as the beauty is not in any highly ornamental works or difficultly molded features, but is in the simple, graceful general proportion of the members. There is not a thing in the viaduct that is out of the way or at all expensive, the beauty the structure possesses coming from a nice arrangement of material rather than extravagant embellishments.

NELSON *Street Viaduct, Atlanta, Ga., a Concrete Structure of Attractive Design.*

The entire work was designed by the Engineering Department of the Trussed Concrete Steel Co., and the designs were approved by D. W. Lum of the Southern Railway. The construction was the work of W. W. Griffin of Atlanta.

Sewage Purification at Madison, S. D.

The Editor of MUNICIPAL ENGINEERING:

Sir—The city of Madison, S. D., has a population of about 4,000 and is not located near any river or stream, therefore when the sewer system was designed and constructed a purification plant was included as a part of the complete scheme.

The plant is located upon low ground about one and three-quarter miles from the center of the city. It was designed to meet the needs of 2,000 actual users, provision being made for the installation of another complete unit of the same size when needed.

The unit consists of an Imhoff tank, a set of three contact beds and three sand filter beds, also sludge drying bed. The tank is 20 feet in diameter and 20 feet deep, from the crest of the outlet thru to the lowest point in the conical bottom. It is built of concrete, wall 12 inches thick and bottom approximately 15 inches thick. All of the interior construction, consisting of distributing and collecting troughs, baffle plates, scum boards, etc., as well as the troughs leading into and from the tank, is of structural steel. All of this steel work was thoroughly cleaned, carefully assembled and was given two coats of Glidden's acid-proof coating; parts inaccessible after assembling were thoroly coated beforehand.

The sludge pipe is of light weight flanged c. i. pipe, 8 inches diameter, the outlet being 4 feet below the crest of the outlet trough, and fitted with a gate valve. The sludge drying bed is 16 by 40 feet, the surface of the bed being about 2 feet below the invert of the sludge discharge pipe from the tank.

The bed was excavated to the proper grade and upon the bottom were laid four lines of 40-inch drain tile, which were led, by means of a header across

the lower end of the bed, into a drain tile, which in turn empties into the main outlet drain along the lower end of the filter beds. After the tile were laid the bed was filled with clean, coarse sand and gravel to a depth of approximately one foot, thus giving ample opportunity for the water to drain quickly from the sludge when emptied upon the bed.

The contact beds are 30 by 60 feet, walls 3 feet 6 inches high and filled to a depth of 3 feet with coarse gravel in sizes ranging from 1 to 4 inches. The entire set of three beds, walls, floors, distributing, feeding and timing chambers is constructed of monolithic reinforced concrete.

The flow of the sewage upon the beds is controlled by 6-inch Miller feeds, and the timing controlled by 8-inch Miller time siphons.

WOODEN *troughs are eliminated by passing sewage through open joints from which it then flows onto the beds.*

The sewage is distributed upon the beds thru tile laid with open joints, the sewage distributing itself out over the bed thru the open joints as it passes thru the pipe. This system has been found to distribute the sewage very satisfactorily and eliminates many of the disadvantages of wooden troughs.

Upon the floors of the beds are lines of 6-inch vitrified gutter pipe, laid approximately 4 feet apart, with header connections across the lower end, which conduct the sewage to the timing chamber thru a grated opening in the wall between the two.

The filter beds are located directly below the contact beds, or adjoining the contact beds on their lower end. These beds are 40 by 60 feet and 3 feet deep. The sewage is distributed in the same manner as upon the contact beds, and the drainage beneath is thru lines of 4-inch drain tile laid about 4 feet apart, these emptying thru a header and 12-inch outlet into an 18-inch main outlet, which passes along the lower end of the filter beds and eventually empties into a small creek about 450 feet distant.

Provision is made for passing the sewage directly into this main outlet drain before reaching the tank, thereby cutting out the purification plant entirely, should the occasion demand, for making repairs or otherwise.

The feeding and timing chambers, also the Imhoff tank, are provided with covers and roof.

The purification plant, as well as the sewer system of the city, has been in operation about six months, and as it was quite late last fall (1912) before the people were permitted to use the sewer, very few connections were made, and the flow thru the plant has been very light.

No investigation has yet been made as to the amount or character of the sludge accumulated, but as the tank was designed for a six months run at full capacity the quantity at this time would be small.

The general design for the tank, giving the principle dimensions, was furnished by Dr. Karl Imhoff, thru the Pacific Flush Tank Co.

The plant was designed by the Missouri Valley Engineering Co., Mitchell, S. D., of which company the writer is president, the writer also being at that time city engineer of Madison, under whose supervision the plant was constructed.

The construction work was done by Tanner Bros., Webster, S. D.

CHAS. A. TRIMMER.
Mitchell, S. D.

Concrete Pipe Test.

By W. R. Harris, Managing Director, The Canadian Lock Joint Pipe Co., Regina, Can.

The following is the report of a test made by us for the city of Regina, Seventh avenue trunk sewer, on a 60-inch Meriweather pipe, 6 inches in thickness.

TEST *of 60-inch Concrete Pipe, showing final load.*

The reinforcement consisted of two rings of American Steel & Wire Co.'s triangle mesh, style 34, giving a total of 1.26 pounds steel per square foot of pipe.

The concrete consisted of 1 part Lehigh portland cement, two parts sand and 4 parts gravel.

The pipe was not damaged by the test and was laid in the sewer. The duration of test extended over 48 hours. After the removal of the men forming part of the final load a load of 11,500 pounds was left on the pipe for 24 hours when an attempt was made to add additional weight in an effort to test the pipe to destruction, but as the bags of sand commenced to bulge the test was discontinued as the pipe had been tested to more than 2½ times the test loading called for in the specifications, i. e. 5,000 pounds per lineal foot. Upon removal of load the cracks noted below closed so as to be barely perceptible. The following test was conducted under the supervision of Mr. J. M. Mackay, then chief engineer of trunk sewers:

Load in Lbs. Per Lin. Ft.	Deflection In Inches.	Results of Loading. Cracks Observed and Remarks.
5,310	None	None
6,600	None	None
7,500	1/16	Very Slight Crack in Invert only.
9,800	⅛	Very Slight Crack in Invert and arch.
12,700	3/16	Very Slight Hair Crack in arch and slightly more perceptible hair crack in the invert. No cracks appeared on exterior of pipe at spring line.

Keep the Street Clean

The Editor of MUNICIPAL ENGINEERING:

Sir—Any one who has noted conditions in the business sections of New York, Boston, Philadelphia, or other American cities, and who has given street cleaning matters any consideration, knows that Chicago's downtown streets receive more attention and are kept continuously cleaner than any streets, subjected to the same traffic and usages, in the country. Within the area cleaned by the citizens' street cleaning bureau the streets are covered by hand from eight to ten times a day on week days and from two to four times a day on Sundays and holidays, and the alleys are swept once each week night. Every square yard of street area is flushed nightly except Sundays, and is sprinkled every day, Sundays included, when the temperature permits.

At times, on windy days, even when the streets are clean and sprinkled, considerable dirt will be noted in the air. This comes, some of it, from the roofs of buildings, but most of it is from uncared for sidewalks.

From the point of view of cleanliness the proper care of the sidewalks is as important as the cleaning of the roadway. For the last year, then, we have given considerable attention to this matter and we expect to take over entirely on the first of May the cleaning of all sidewalks, and it is our intention to sweep them thereafter at least four times a day.

Another activity which makes for cleanliness is the removal, under conditions which insure as little objection as possible, of cinders and rubbish from more than 160 downtown office buildings, stores, etc.

Plans are under way for the removal of the present unsightly sidewalk boxes in which sweepings are deposited and the substitution of boxes sunk in the sidewalks and of sufficient capacity to care for all the sweepings accumulated thru the day. These boxes are to be emptied at night only, thus obviating the necessity of loading and removing any refuse through the streets during the day.

There is one step further that we might take in caring for our district, and that is the cleaning of the roofs of buildings, which collect much of the emissions from smokestacks and other dirt. These collections later are searched out by high winds and scattered over the streets and sidewalks and into buildings.

In comparing American and European cities it may be noted, as is well known, that the latter have generally better pavements and they are kept constantly in repair.

The greatest contrast in street conditions is evidenced in the rigid enforcement by European cities of the ordinances prohibiting any littering of the streets. If a citizen throws a piece of paper in the street he is arrested at once, and, what is more to the point, he is fined. In this country he thinks nothing of the practice and would be dumbfounded if arrested and outraged if fined.

The control of building operations affords another contrast not in our favor. Abroad no building material is allowed in the street except that which can be handled in no other way. Here we give the contractor a permit setting aside, in many cities, the space directly in front of his premises and extending out one-third of the width of the street. In effect, the street is narrowed one-third. Therefore traffic is congested and delayed at this point.

Materials of all kinds are dumped here, unconfined, and some of them are tracked and blown about the streets to the discomfort of pedestrians and at an added expense to the street cleaning departments.

In other words, we turn over the public street, however busy or important it may be, to the contractor for storage purposes. We allow him to inconvenience the public, to interfere with traffic, and to have his material scattered over the street to be swept up at the city's expense.

The sidewalks also are occupied to a greater extent than necessary. The least that should be required of a contractor is to confine the materials and to pay any extra expense in the way of street cleaning his work involves.

The presence of these conditions does not mean that we cannot have clean streets, but it does mean that they are a source of annoyance and an unnecessary expense to the city that should not be countenanced.

RICHARD T. FOX,
General Manager Citizens' Street Cleaning Bureau, Chicago, Ill.

Records in a City Engineer's Office

The following extracts from a city engineer's report show, by their demonstration of what his office did not contain when he assumed it, what it should contain. Unfortunately, in the average small city, no one has interest enough, and no one has the responsibility for the records of the city engineer's office at the time of change of administration to see that they are kept properly and are transferred from each engineer to his successor.

The same complaint is made of other offices.

Possibly the best solution of the problem is an extension of the supervision of accounts of county and city officials by a state board, such as is in operation in Ohio, Indiana, and a few other states, to cover all office records, no officer to be released from his bond on leaving his office until he has made the records and transferred them to his successor to the satisfaction and certification of the state inspector.

All parts of the report have been omitted but those describing the conditions which should not exist.

"Upon my induction into office on May 1, 1911, I took an inventory of what I found in the office. It consisted of one chair, one stool, one old drawing board, one roll top desk (out of repair), one small table, and one large table on which was lying a very large and cumbersome book which purported to be a plat record of sewers of said city and another large volume purporting to be a profile book of street grades; one K. & E. Y-level about three years old, one K. & E. engineer's transit, same age, but which had to be repaired before it could be used; one 75-foot steel tape that had been repeatedly broken and patched; one old dilapidated 'New York' leveling rod; one sledge hammer and a large crow-bar. These were found and have been carefully preserved, the tape and rod being kept chiefly as relics of antiquity, but I have frequently 'sighed the lack of many a thing I sought' in the way of records that should have been there to furnish needed information.

LACK of enforcement of city ordinances has prevented the office of this engineer from being properly equipped with important data.

"I have made no private surveys of lots, partly because I have had little or no time for such work, and partly because of the absence of monuments in the street intersections, and the lack of records or notes in my office of land marks. However, many lots have been surveyed by other parties, but I have no record of them, notwithstanding the following requirements of Section 1004 of the City Code, viz: 'Any other person making any survey of any land within the corporate limits of said city, shall, within ten days thereafter, make out and deliver to the city engineer a description of such survey,' etc., and the same section later provides a penalty for failure to comply with its requirements.

"Of plats, profiles, plans, etc., there were practically none in the office when I took charge of it, except those of the north end sanitary sewer system, recently constructed, and the plans for the proposed combined sewer systems in the south portions of the city. Not even blue print copies of plats made last year at the expense of the city were left in the office, nor the tracings of same from which additional prints could have been made if needed. As a result, it was found necessary to make some of them again for which we 'now pay as if not paid before.' Not a field book, level book, or note book of any description was turned to me by my predecessor, altho all such that have been heretofore purchased by the city and used by the city engineer while working on a salary, should have been left and carefully preserved in the archives of the office. My predecessor did copy into a note book which I provided for the purpose and at my own expense, the notes as to locations and elevations of about 125 bench marks scattered over the city east to Third street; but he did not

leave any such notes as records of the office altho the code requires such.

LACK of proper monuments and corner stones at important points may be cause for litigation involving valuable property.

"I feel that it is my duty to call your attention particularly to absolute lack of monuments or corner stones marking the centers of street intersections in by far the greater portion of the city, in fact there are but four or five places where I know them to be, and these places are remote from the principal business section of the city. This lack of permanent marks is liable to cause an endless amount of litigation among property owners in the future, unless steps are taken to have such monuments planted before reliable notes now existing (but not in possession of the city) are lost or destroyed.

"The sewer records are very incomplete, inaccurate and unreliable, in that they show no depths, do not show the sizes of all sewers or the date when constructed, and not all sewers are shown thereon. We have no record whatever as a guide to the location or number of lateral junctions in any of the many sewers constructed prior to the year 1906.

"As there is no record in this office showing the total amount of paving that has been done in the city, the date of construction, kind of pavement, first cost, total cost, and present condition, a search should be made of the ordinances and contracts in the comptroller's office, and as much of this important information collected as possible, and tabulated for convenient reference.

"Altho section 1000 of the City Code requires that the city engineer 'shall construct and keep in his office a correct map of the city, showing thereon the several additions thereto, the streets, lanes, avenues, alleys, public landings, squares, buildings and city property,' etc., no such map was found in the office when I took charge of it, nor have I had time during the past year to make such a map. However, I regard the provision of the City Code as a wise one, and it should be complied with as soon as possible, even if it involves the employment of an additional draughtsman.

"I have mentioned at length and in detail many of the matters above noted for the purpose of impressing you with a sense of the danger attending such lack of records and permanent monuments, and to call your attention particularly to the manifest inadequacy of the appropriations that have been made for this department for several years past (just large enough to pay the salary of the city engineer alone) inadequate in view of the vast amount of work that should be done in order to properly equip the office with maps, plats, profiles, records, etc., and at the same time keep up the routine work of the office, in addition to discharging the multiplicity of duties devolving upon the city engineer as a member of the Board of Public Works and of the Board of Local Improvements.

"The lack of a filing cabinet with drawers of sufficient size to be suitable receptacles for blue prints, plats, profiles and tracings, is keenly felt in the office, and I would urge that one be provided as soon as possible to avoid a waste of time in searches that would be unnecessary were there such a cabinet in the office. Likewise, a card index would be a great time saver in the office.

IT is of essential importance that the office of the city engineer should be thoroughly equipped with modern devices and methods.

"As there is no office in the city government that is of more vital importance to the property owner and taxpayer, I see no good reason why it should be the most poorly equipped, or so nearly disregarded in annual appropriations. Rather, it should be equipped in the most modern and up to date manner and ample appropriations made so that the work required of the office could be done and done promptly without having to encroach on the funds of some other department. Such method as above suggested would be only patterning after other cities of our class, which are alive, awake and up to date."

Results of an Efficiency Survey of Los Angeles

The committee on efficiency of the Municipal League of Los Angeles, Cal., secured the co-operation of the New York Bureau of Municipal Research in a general survey of certain functions and activities of the city government of that city and the latter organization has made a report criticising methods and conditions found in the few departments investigated, making some constructive suggestions and recommending the immediate establishment by the citizens of a local bureau of municipal research to co-operate with and assist the Los Angeles city and county officials in improving conditions and methods and therefore obtaining results.

The bureaus and methods investigated were those of assessment and collection of taxes, audit of revenues due and col-

lected, budget making, salary fixing and payment, purchase of supplies and materials, handling of funds in city treasury, printing council proceedings, constructing and maintaining public works, such as streets, sewers and aqueducts, street cleaning and garbage removal.

CONDITIONS *were found which, if corrected, would necessitate a change in statutes or in the city charter.*

Certain defective conditions will require changes in statutes or city charter; viz., collection of taxes on unsecured personal property by the assessor; purchase of supplies and materials; restriction of maximum interest on city deposits to 2 per cent.; determination of kind of pavement for a street by city council instead of by engineering department. Some of the difficulties will be modified by consolidating the city and county governments.

Tre recommendations of new methods to replace the present defective methods include the following:

Asscssment of Taxes—Selection and employment of several assessors instead of but one, merit to govern appointments and continuance in office; judgment of several as to values; assessment of property at full value; assessment from plats and not from property owners' lists, which would prevent omissions and make assessments more uniform; collection of taxes taken from assessor and put in the hands of collector.

Collection of Taxes—Billing in duplicate with receipt and schedule for auditor; collection of taxes on unsecured personal property after year's tax rate is fixed rather than on basis of previous year with supplementary collection of small amounts if tax rate is increased, and collection by collector, not by assessor; provision of a working or petty cash fund of $1,000 to be balanced each month.

Audit of Revenues Due and Their Collection—Prebilling of taxes as above provided will enable auditor to verify tax rolls and keep track of amounts paid and unpaid; duplicate of water bills in auditor's office would give similar checks on amounts due, amounts paid and amounts unpaid, which is now impossible; same applies to payments due under leases, franchises, licenses, permits, etc., the documents to originate with the auditor and all such documents to be accounted for by number to the auditor at end of each month.

Standardizing Salaries—Payrolls with 2,400 office and skilled employes and over 6,000 laborers, not including school fund, and approximating $3,000,000 a year should be on a standard basis of salary rates. This may be done by classifying the positions, fixing salaries and titles to suit the work done, adopting these titles, rates and classes as standard, establishing efficiency ratings, making promotions and demotions in salary rates in accordance with fixed schedule of salary and efficiency ratings.

Purchase of Supplies and Materials—Specifications for all materials and supplies possible should be prepared and purchases made under them, inspections to be made by the purchasing agent's or preferably the auditor's office, issues to be made from store house by auditor and store keeper's stock ledgers or shelf cards to show current inventories.

BUDGET *publicity advocated, as well as more efficient accounting and the keeping of unit costs in order that appropriations can be made with intelligence.*

Budget—Should be more publicity of details by printing the budget as presented to council and full advertising of public hearings; adoption at one time instead of in various ordinances covering parts of the budget, this time to be before the election, or after the new administration has assumed office; there should be more efficient accounting for appropriations and supervision over supplementary appropriations and transfer, such as would be obtained by requiring the approval of a controller, who, in Los Angeles, may be the city auditor; auditor should keep track of balances in the various appropriations and report them monthly to the departments; schedules of unit costs and of past year's expenditures should be kept for comparison and check; disbursing officer should pay city employes at or near their work on a schedule arranged by telephone or other order instead of requiring them all to come to the city hall.

City Treasury—Millions of dollars are held for indefinite periods without interest, when all but a few thousands should be in the bank deposits drawing 2 per cent. Sinking funds should be invested in 4 and 4½ per cent. securities bringing increase to the fund instead of profit to the banks. Bonds should not be sold far in advance of necessities for which the city pays 4 and 4½ per cent. and receives 2 per cent. or nothing from the resultant cash as long as it is on hand.

Printing Council Proceedings — This seems to be a source of petty waste which attracts considerable attention and which amounts to a number of thousand dollars a year, which would be saved by properly editing the copy for the printer.

Constructing and Maintaining Streets, Sewers, Aqueducts, Etc.—The kind of

pavement to be used should be decided on scientific principles by the experts, not by the city council. Extensions of time on contracts are too easily obtained. Connections to public utilities should be made before paving. Street intersections should be paved with the first street paved. Unit and total costs should be printed in reports made annually, such reports being largely lacking in the past. Methods used by the aqueduct and power boards are excellent. Street maintenance is by city forces and power should be given the chief inspector in charge which is commensurate with his responsibility. A municipal asphalt repair plant should be provided without delay. Cost of repairs in totals of amounts of work and money and in units should be kept for benefit of both construction and maintenance departments.

RECOMMENDATIONS *were made which would put the street cleaning department on an efficiency basis.*

Street Cleaning and Garbage Removal—Being under the same bureau as street maintenance, this is subject to the same criticisms. Efficiency records should be kept, also sufficient records to make possible the computation of unit costs and comparisons of work done and cost of doing it. Stable and stores accounts should be kept in detail and the present open leaks should be stopped. Uniforms are recommended. Cans for holding sweepings are advisable. The park department does not co-operate in proposition to utilize street sweepings as fertilizer. There should be a system of discipline which would keep men at work efficiently. The only present punishment for infractions is discharge or lay-off. The garbage question has been a burning one for several years and is not yet solved. Advertisements have been published calling for bids per ton for disposal by incinerator, reduction or a combination of the two of all garbage and dead animals and for specifications for the erection and equipment of a plant for the incineration or reduction of garbage, dead animals, market refuse and combustible rubbish.

Dean Goss Is Chicago Smoke Prevention Engineer

W. F. M. Goss, dean of the College of Engineering of the University of Illinois, has been granted a year's leave of absence to enable him to direct the completion of the investigations of the committee of the Chicago Association of Commerce on smoke abatement and electrification of railway terminals so well begun by the late Horace G. Burt.

Dr. Goss is at present the president of the American Society of Mechanical Engineers and is a member and past or present officer of many other technical societies of note. He bears the honorary degrees of Master of Arts and Doctor of Engineering. He graduated from the Massachusetts Institute of Technology just as Purdue University was beginning its courses in mechanic arts and entered its faculty at once. He soon became the professor of practical mechanics and made a great reputation for himself and for the school in the development of that earliest school in the West to give practical instruction in shop practice. One of his most successful educational methods was the encouragement of research work and his laboratories and shops were noted for the practical value of the results of the investigations carried out in them. The locomotive testing laboratory was perhaps the most widely known piece of equipment, and has been the source of much information upon the use of steam.

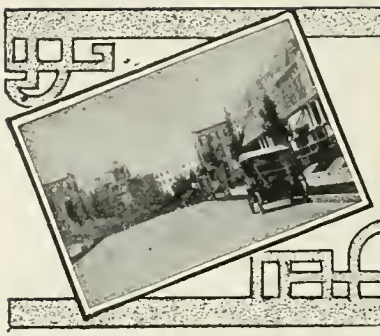
Since 1907 Dr. Goss has been dean of the College of Engineering of the University of Illinois, in which position with added facilities he has increased his reputation as a thorough investigator with unusual ability to make practical applications of the results of investigations made by himself and under his direction.

The Chicago Association of Commerce is fortunate in securing the services of so competent an engineer to carry on its work of smoke prevention.

The Largest Bascule Bridge in the World

What is said to be the largest bascule bridge in the world has just been completed at Portland, Oregon. This new bridge, which is 4,800 feet long, crosses the Willamette river, connecting Broadway street on the west side with Broadway on the east side. It provided an easy grade thoroughfare from the business district to the large residence district on the west side. This type of bridge allows practically unobstructed water traffic up and down the river. It was built by the city at a cost of about $1,300,000.

The bridge is lighted at night by 250 5-light and 2-light fixtures, together with an outline scheme of 7,000 lamps spaced 18 inches apart. One hundred-watt tungstens are used in the pole fixtures and 32-candle power lamps on the outline system. Current is supplied to the lamps over more than 12 miles of wire in metal conduit.



ROADS AND PAVEMENTS

Methods Which Have Developed Successful Concrete Pavements

WAYNE COUNTY, Mich., has become famous for its concrete pavements. This article shows the basis for this reputation and states the lessons which have been learned, so that other cities and counties may see what they are. The probable relation of the new "paving determinator" to future improvement is also stated.

THE concrete pavement has been in use now for many years, and the first street pavements of any considerable extent in this material are now in daily use after some twenty-two or twenty-three years of wear on the principal business thorofares of Bellefontaine, Ohio. Like most other pavements, it has had its troubles and many experiments have been necessary to determine the reasons for these troubles and the methods of obviating them. They have not all disappeared, and there are some troubles, the reasons for which have not yet been found or, at least, the methods for preventing have not yet been so perfected that the action of a given pavement can be definitely predicted in advance.

Thus far certain principles, which have been discussed in various articles in MUNICIPAL ENGINEERING, have been quite clearly indicated as essential to success, and most of the failures which occur in concrete pavements can be traced to the departure therefrom of the contractor or the engineer or the board having the work in charge.

Wayne county, Michigan, including Detroit and other municipalities within its borders, is a district which contains more successful concrete pavements than any other equal area in the country. Some discussion of these pavements, based on a recent examination of some of them by an editorial representative of MUNICIPAL ENGINEERING, may show what are the elements of their success and what efforts are being made still further to improve the quality and durability of concrete road and street pavements.

THE *reasons for the development of concrete roads about Detroit, Mich.*

This development of concrete roads in and about Detroit was probably due in the first place to the fact that other hard paving materials of first-rate quality are more expensive, on account of freight, than is concrete, and also to the rather poor quality of the earth as a foundation for any pavement not strong enough to take care of inequalities in settlement which may develop. Constant attention to the matter by public-spirited officials, not to mention those directly interested in the success of the materials they supply, has led the way through a series of well-devised experiments to the present excellent results and is continuing them in the lines whose correctness has been so well demonstrated.

Edward N. Hines, the chairman of the board of county road commissioners, says that "Wayne county is in a valley, is flat, and not easily drained. It consists largely of a clay subsoil. Here and there we strike stretches of sand. Our first experience was along the line of bituminous macadam construction, which we felt was not a success, in our locality at least. We built rock asphalt, we built brick, we built tar macadam, we built asphalt macadam, and we built plain water-bonded macadam. Our experience was unsatisfactory in all those materials, with the exception of brick, and the cost of brick in our locality for our purposes is prohibitive. From observations based upon the experiences of near-by country towns with bridge floors and with cross walks built of light concrete construction, we decided that concrete would solve the problem for us. We devised the concrete road, of which we have about 65 miles, and expect to add some 40 miles during 1913."

Concrete in a road surface is subjected to the most severe tests to which it is possible to subject this material. The stone of which it is composed must be the most durable which it is possible to secure. Both sand and stone must be the cleanest and best product obtainable, the proportions of sizes of stone and of sand to stone must be such as to utilize the stability of the stone to the utmost, and the methods of putting these materials are excellent, those built across the river in Windsor, Canada, are much less so, because the materials are not so clean nor so carefully proportioned, the concrete is not so rich in cement and the mixtures are not so carefully made.

The sub-grade is rolled level and hard, the better the sub-grade the better the final pavement. Wherever the moisture in the subsoil requires it, drains should be laid, so that the sub-grade will never

CONCRETE HIGHWAY IN WAYNE COUNTY, *Michigan, about five years old, not reinforced. General condition excellent. Note longitudinal crack and one break in right-hand corner. Joint in foreground has bituminous filler.*

together must be such as to produce perfect mixtures and to keep them perfect until the material is tamped into place in the roadway.

The city of Detroit proper has constructed but little concrete pavement.

Adjoining villages, such as Highland Park, Hamtramck and Springwells have used concrete on a larger proportion of their street work. The best specifications require broken stone in the first course and crushed granite as the aggregate in the wearing surface. Streets in which these materials are used, and especially those in which steel reinforcement has been used, show practically no wear after two to four years of traffic.

Wayne county specifications require the use of washed gravel ¼ inch to 1½ inches in size and sand from ⅛-inch down to dust, and the proportions found proper with these materials are 1 part cement and 3 parts of gravel, with sand enough to fill the voids, usually 1½ parts. While the roads built with gravel in that county stand full of water. Most of the failures in concrete pavements are attributed to unequal settlement in the sub-grade, either from poor rolling, water draining in or variations in quality of material in the foundation. Nearly all of the remainder are attributed to expansion and contraction under changes in temperature. These temperature cracks may be due to the lifting of the center of pavements laid with a crown. Wayne county uses a level cross section of sub-grade and a crown of only ¼ inch per foot on the surface, thus thickening the concrete in the center of a 16-foot roadway two inches. There is therefore little if any tendency for the crown of the road to lift with rise in temperature.

Solid sub-grade and lack of crown have materially reduced the danger of cracks and there are continuous miles of Wayne county roads with only an occasional longitudinal crack. This is not true of the streets in Windsor, above referred to.

ELMWOOD AVENUE CONCRETE PAVEMENT, *Detroit, Mich., not reinforced. Note cracks, longitudinal, transverse and irregular.*

Almost every block in every street a year or more old has at least one crack and many have more than one.

STEEL *reinforcement has proved a great factor in the success of concrete pavements.*

It is believed by some engineers that proper reinforcement with steel will prevent temperature cracks and also will make each slab self-supporting, thus bridging any low spots in the sub-grade due to settlement and soft spots due to excess of moisture. This reinforcement adds to the cost so that it has not been applied as yet to county roads.

The village of Highland Park is using reinforcement in many of its concrete streets. In work done by R. D. Baker & Co. this reinforcement has been in the form of rods run each way to prevent both longitudinal and transverse cracks. They are now using wire mesh in sections wired together. This reinforcement is placed between the upper and lower courses of a two-course pavement, being laid on the lower course before the wearing surface is placed.

The village of Springwells is using the Thomas system of reinforcement. The feature of this system is the stool which is used to keep the reinforcement in place and tie it together. There are two sets of rods, one set 2 inches above the bottom of the stool and one at or near its top, which is at or near the junction of the two layers in a two-course pavement, or 2 inches below the wearing surface in a 7-inch one-course pavement. The reinforcement for a block or for a half block is put together outside and is set in place complete on the foundation and is then ready for filling in the concrete.

Neither form of reinforcement seems to be an absolute guaranty against all cracks, but a comparison of streets of approximately the same age and specification laid by the same contractor with and without reinforcement shows clearly the value of the reinforcement in removing nearly all the causes for cracking.

WAYNE COUNTY *has proved that in order to reduce repair charges to a minimum carefully constructed expansion joints are essential.*

One development in the Wayne county pavements seems to settle the question of protection of expansion joints. In the early history of concrete pavements the joints left to take care of expansion and the grooves made to reduce slipperiness of surface were a source of constant trouble, as the corners rapidly wore away and increased the opening left in the pavement, holes spreading rapidly therefrom. Three methods of protecting these joints have been devised in Detroit, which have shown that it is possible to prevent this concentrated action on the edge of the concrete. All three methods provide for thin steel plates attached to the concrete slabs, which protect the concrete surface and wear at the same rate as the

concrete. The plates being of thin soft steel, this claim is reasonable, and experience is showing practically that it is correct. Between the two plates and their slabs of concrete a filling is placed which contains more or less bituminous material. In some contracts it is the ordinary tar filler, in others it is an asphalt filler and in others it is a quarter-inch or so of tarred felt. In each case it serves to take up the longitudinal expansion of the concrete blocks, which are ordinarily about 25 or 30 feet long. When the tarred felt is used it is possible to use the method observed on one of R. D. Baker & Co.'s contracts. A template having the form of the street cross section was set upside down on the sidewalk. The two plates were bent to the form of the template and the felt was put in place between them, extending up beyond them a distance equal to the whole depth of the concrete. The plates were then clamped together. The combination, ready for use, was swung across the street, turned over and put in the position fixed for the joint. The concrete was then filled in on both sides, the clamps being removed as required. The joint is then ready for use without further attention. If a tar or asphalt filler is used a board can be used instead of the felt, and when the concrete has set the board can be removed and the open joint filled with the hot pitch.

THREE *Joint Protectors Developed.*

The differences between the three forms of joint protectors are in the methods of joining them to the concrete. All three cut tongues at intervals in the steel plates. The Baker tongues are bent at an angle of 45 degrees with the plate and when the concrete sets they hold the plate firmly in contact with the edge of the block. The Kahn tongue has a slit cut in its end. The tongue proper is bent at right angles with the plate and the ends down to the bottom of the slit are bent in opposite directions so that they form a T, with the top line perpendicular to the tongue and parallel to the plate proper. They thus form anchors which likewise hold the plate in close contact with the edge of the concrete block. The Thomas tongue is bent into the form of a stirrup. A double hook is then placed with one bend in the stirrup and the other over the near-by rod of the reinforcing system. The protection plate is thus held in close contact with the edge of the concrete and also is joined to the reinforcing system of the whole block.

All three systems are efficient and reliable and, so far as experience with them has gone, show a practical solution of one of the greatest problems of the maintenance of a concrete pavement.

Wayne county, Michigan, and the villages located in it have placed the rest of the country in debt to them for the thoro manner in which they have made their experiments on concrete pavements. While their results are not all good, they have shown a steady improvement, and

CONCRETE PAVEMENT, *Detroit, Mich. General condition excellent. Note perfect steel-protected joints. Spot on left is a cut, temporarily filled with earth and planks on top. Note level street, with straight grade at center and breaks in curb grades to give drainage for gutters.*

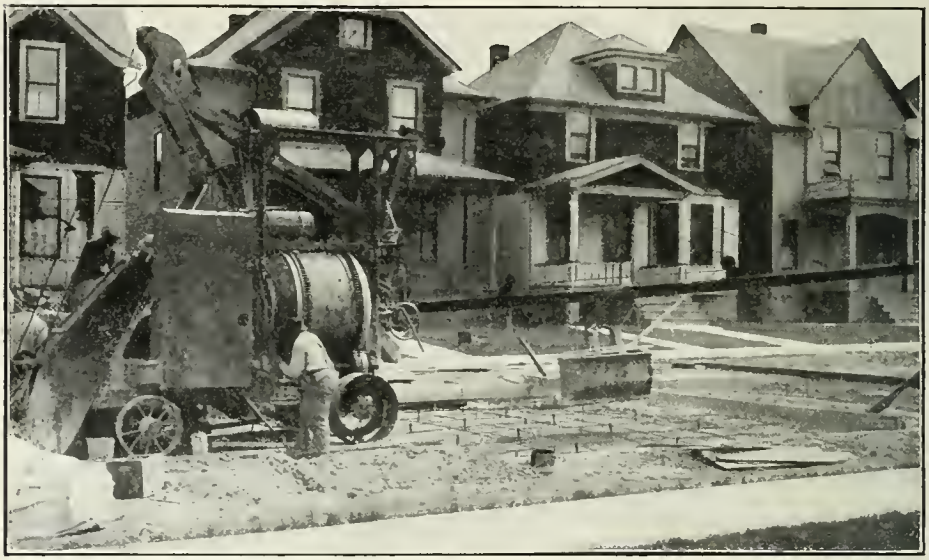
the failures are quite as valuable to others as are the successes.

Neither can it be said that all the problems have been solved, but the rapid and thoro methods of experiment and the courage which has led to the construction of so many miles of pavement in the face of problems whose solutions were doubtful, has produced results only comparable with those produced in the brick paving field by Cleveland and Cuyahoga county, Ohio, where equally valuable results are to be seen in another most important branch of the paving industry.

A machine has been devised in Detroit for the testing of pavements which has much promise and by producing a concentration of wear will shorten the necessary period of observation and thus give information regarding the effect of any modification of construction on wearing qualities within a few days, which could be obtained on the road only after months or even years of study. This machine was devised to test the paving materials in use in the city and is the product of the ingenuity of the city boiler inspector, John C. McCabe. He was called upon by the mayor to make an investigation of the quality of the paving materials used in the city, more particularly the various kinds of brick in use, and he was not satisfied that the standard tests for the adoption of brick for new construction would give him the information he desired.

THE *"Paving Determinator" which is designed to duplicate traffic conditions and with which efforts are being made to determine the value of different materials, methods and designs.*

The machine consists of two heavy steel discs of the diameter of a wagon wheel, set at the ends of a horizontal axis, which revolves about a vertical axis at its middle point. The discs, having the width of an ordinary wagon tire, represent the wear of such tires on the surface over which they travel. Attached to each of these discs are three or more flat discs with calks on them, which represent the bottom of a horse's foot, which strike the pavement surface in a manner somewhat similar to a horse traveling over it. The combination therefore represents the travel of horses and wagon over a pavement.



CONSTRUCTING REINFORCED CONCRETE PAVEMENT, *Detroit, Mich. Note reinforcement in place, concrete mixer with boom and traveling bucket, placing first layer of concrete. Protection for joint in place at the right.*

As the machine revolves the large discs gradually increase and decrease their distance from the central axis by means of a worm gear, so that the pavement wear is distributed over an area 27 inches wide. Any practicable speed of travel can be produced.

The paving materials to be tested are laid in the circular 27-inch belt according to the specifications for the construction under study, and when ready for travel the machine is started up and any

desired ton mileage of traffic can be run over the pavement at any horse-vehicle rate desired.

The idea of the machine is so new in most of its details that its application in practice has not been standardized. So far the lessons learned are largely as to what not to do, but there are possibilities in it quite as attractive as those in the first rattler for testing brick, so that it is evidently worth while to continue work with the machine until the practical connection of its results with those of horse traffic on the ordinary road or street has been made. After 25 years of study the brick rattler has barely been standardized and some improvements are still in sight. It may not take so long to standardize the "paving determinator," as the new machine is called.

Creosoted Wood Block in Cincinnati

By H. M. Waite, Chief Engineer of Cincinnati, O.

The development of motor vehicles has caused a greater demand for smooth pavements, with easy gradients, free from abrupt dangerous curves. The extending use of high speed motor delivery trucks makes such pavements an economic necessity, especially on the main arteries of travel leading to the suburbs. Aside from the aesthetic, sanitary and smooth riding qualities of such pavements, they not only reduce cost of deliveries, but also greatly prolong the life of the vehicles themselves; an extremely important matter when we consider the already enormous and rapidly increasing investment in motor vehicles. It is with these objects in mind and also to prolong the life of the pavement that the department has been using portland cement grout for filling the joints between the blocks in granite pavements. Ease of cleaning by the use of modern flushing machines and the reduction of noise are also important considerations tending to the use of smooth pavements.

Prices for Pavements.

The following prices for pavements are based on the bids opened during 1912. These prices include excavation equal to total thickness of pavement, all rolling of subgrade, the foundation and the surfacing complete. Asphalt, brick, bitulithic, granite and wood blocks have a 6-inch portland cement concrete (1:3:6) foundation. The waterbound macadam is 12 inches thick and the bituminous macadam 9 inches thick. The concrete pavement is 7 inches thick, laid on a 4-inch bed of cinders. The asphalt has 1½ inches of binder and 1½ inches of surfacing; the granite blocks are 5 to 5½ inches deep with close joints; the wood blocks are 3½ inches deep with an 18-pound per cubic foot treatment; the bitulithic has a 2-inch wearing surface.

The most economical pavement to use under any given conditions is that which will show the lowest average cost per year during the entire period of its existence. Thus a pavement having a relatively high first cost may, owing to its longer life or lower cost of repairs, prove ultimately cheaper than one lower in first cost. This principle of average annual cost should be thoroly understood, as it is fundamental in determining a sound and economical paving policy for a city.

The average annual cost of a particular pavement may be defined as that amount of money which, if contributed annually, will, under the existing conditions, keep the street perpetually paved and repaired. The average annual cost is composed of three principal factors: 1. Average annual cost of repairs; 2, interest on the cost of the pavement; 3, annual charge on account of sinking fund; i. e., a fund set aside and invested each year such that the pavement, when worn out, will have been completely paid for.

This average annual cost might be

Kind of Pavement	No. Contracts on which Bids opened	Number of Square Yards	Minimum Price	Maximum Price	Weighted Average Price
Asphalt	17	56,153	$2.20	$2.63	$2.43
Bitulithic	1	550	2.80	2.80	2.80
Boulder	1	240	2.10	2.10	2.10
Brick	29	65,030	2.00	2.65	2.27
Concrete	3	800	1.60	2.25	2.00
Granite	19	69,905	3.32	4.30	3.72
Macadam (waterbound)	8	10,980	.90	1.50	1.03
Macadam (bituminous)	20	84,155	1.20	1.65	1.31
Wood block	8	32,340	2.97	3.60	3.22

imagined as a rental. If the streets were laid and kept in repair under a continuous contract with a private corporation, the average annual cost, as above described, plus profits, would make up the rent demanded by the corporation. In the long run, the cost to the citizens under the present methods has to be figured in the same way.

THE *necessity for exact data covering long periods in order that correct costs may be arrived at.*

In order to apply this principle to the selection of a pavement for a given street, certain exact data are necessary, such as the durability and cost of repairs of each kind of pavement under various conditions, especially those of traffic. As a matter of fact, the information of this character which is available in most cities is meager and fragmentary, due doubtless to the long period necessary for such an extended investigation and the lack of continuity of records thru changing administrations.

We have in this city a considerable yardage of creosoted wood block paving, 18,900 feet being laid in 1908, 5,044 feet in 1909, 13,577 feet in 1910, 3½ miles in 1911 and 7,437.4 feet in 1912, as follows:

Our creosoted wood block pavements which are on the main arteries of travel have not been laid a sufficient length of time for the compilation of maintenance and up-keep figures and besides there have been none to our knowledge. The guarantees, of course, have not as yet expired, but we understand that the cost of maintenance has been practically nothing.

Creosoted wood blocks make a comparatively noiseless, sanitary and smooth pavement, which is easy to clean, and give satisfactory results as to durability. They give highly satisfactory results for heavy, medium or residence street travel. Being a jointed pavement, it is easy to repair. Its first cost is somewhat high, but when considering the advantages, the cost of maintenance and life, the influence of high first cost is materially reduced.

Practically all of the wood block laid in this city has been Southern yellow pine 3½ inches deep, 3 inches wide, treated with twenty pounds of oil to the cubic foot of wood. The character of the oil used however, has differed materially on different contracts. On some, the specifications required that the oil should not contain over 2½ per cent. of insoluble matter and that it should have a gravity

Street.	Length Feet.	Total Cost.	Year Laid.
Beekman Street	1,200	$22,989.41	1908
Grant Street	400	4,560.68	1908
Ninth Street	1,700	29,086.19	1908
Burnet Avenue	4,000	80,463.97	1908
McMillan Street	1,700	29,491.22	1908
Central Avenue	250	5,941.46	1908
Cross Lane	250	5,450.61	1908
Bank Street	1,800	27,025.86	1908
Josephine Street	900	15,851.01	1908
Glenway Avenue	6,700	125,274.42	1908
Locust Street	400	8,031.28	1909
Ludlow Avenue	1,624	28,051.60	1909
McMillan Street	2,805	46,321.17	1909
Pike Street	215	2,904.10	1909
Chase Avenue	4,209	61,494.70	1910
Clinton Springs Avenue	708	10,010.62	1910
Cross Lane	443	8,778.11	1910
Erkenbrecker Avenue	2,396	39,392.46	1910
May Street	1,071	14,114.71	1910
Rose Hill	4,750	55,669.95	1910
Jefferson Avenue	150	3,000.29	1911
Ludlow Avenue	1,100	24,378.22	1911
Ohio Avenue	2,100	28,478.97	1911
Reading Road Boulevard	11,500	271,298.17	1911
Whiteman Street	300	4,644.73	1911
Eden Avenue	700	22,685.57	1911
Bethesda Avenue	700	29,387.95	1911
Melish Avenue	1,600	23,726.03	1911
Garrard	376	7,437.96	1912
Harrison	4,190	90,718.28	1912
Sycamore	2,473	34,607.77	1912
Twelfth	398	6,598.63	1912

of at least 1.10. Later the specifications required a distillate oil with this gravity. We now allow 5 per cent. insoluble matter.

Creosoted wood block pavements are not affected by variations in temperature. The durability of these pavements is conclusively shown in their continued use for many years on some of the heaviest trafficked streets of European cities. The Rue de Rivoli, Paris, over which pass 42,035 vehicles per day, is paved with creosoted wood blocks, so also is King William St., London, with its 26,793 vehicles per day. In Liverpool it has been shown that creosoted wood blocks in a street subjected to a traffic amounting to 302,000 tons per yard width per annum have withstood this enormous traffic for twenty years. There is no street in any American city that is subjected to such severe tests.

Tarred Stone Coating for Old Cobblestone Pavements

By A. Grimshaw, Dresden, Germany.

The tearing up and leveling down of old cobble or brick streets being even more expensive than merely paving good new surfaces, it is often much more economical and satisfactory to let the old paving remain where it has been so long and is not likely to settle, and to give it a modern and practical covering.

Recently extended experiments have been made with a top coat of finely broken stone mixed with tar; and one set of tests on a large scale under practical conditions has been made recently by the Berlin municipal authorities on a reach of street in the suburb of Lankwitz.

Of course, covering an old cobblestone pavement with a mat of asphalt is nothing new; but such a covering has the disadvantage of furrowing very soon under heavy loads, and especially in hot weather. Filling the joints with cement concrete or mortar is also unsatisfactory, as the new material has no good hold on the smoothly-worn surface of the cobbles.

The experiment in the Kaulbachstrasse in Lankwitz was carried out by first cleaning out all the loose material from between the stones, and then ramming them down so that their highest spots came in a common level. Next the whole was allowed to get thorely dry, and on the dried surface there was laid a coat of stone about two centimeters (0.8-inch) thick, followed by one of more finely crushed stone. This double coating was lightly rammed firm, and then came an upper seal coat of tar and crushed stone, about 2 or 2½ inches in thickness, well compacted with a steam roller.

The result is a surface which can hardly be distinguished from an asphalt street; and it is expected thereof that it will be practically noiseless and dustless; and, being quite durable as against mechanical abrasion, comparatively dustless. It should also tend to bind dust carried from other reaches.

To keep this road in order, it will only be necessary to give it, every two years, a top dressing of thin prepared tar for the purpose of binding the dust. On the short reaches, this surface will be satisfactory on grades of one in twelve; and, indeed, as in Manchester, England, it has been used on grades of one in seven. It remains rough, thus giving the necessary hold for the horses' hoofs; does not get slippery in wet weather, and may be cleaned without difficulty by the ordinary apparatus of the street cleaning department.

Proper choice of the proportions of tar and broken stone gives a surface that does not get soft in hot weather or brittle under the action of frost. The rate of wear is naturally dependent upon the kind and frequency of the traffic.

The New York Sewer Plan Commission

The Board of Estimate and Apportionment by resolution has appointed a commission of engineers to co-ordinate the work of the Metropolitan Sewerage Commission with that of the various boroughs of the city, which will be known officially as the New York Sewer Plan Commission.

The Metropolitan Sewerage Commission is reaching the end of its assigned task and is expected to make its final report to the Board of Estimate and Apportionment in a few months.

The new commission, which will take up the development of a plan of main drainage, sewage collection and disposal, to produce practical solutions of the problems discussed by the Metropolitan Commission and the various borough engineers, is made up of the chief engineer of the appointing board and the consulting engineers of the various boroughs, Ernest P. Goodrich for Manhattan, Geo. W. Tillson for Brooklyn, Amos L. Schaeffer for The Bronx, Foster Crowell for Queens and Louis Tribus for Richmond. Nelson P. Lewis, chief engineer of the Board of Estimate and Apportionment is chairman of the new commission and Charles E. Gregory, deputy consulting engineer of Manhattan has been selected as executive secretary.

The Metropolitan Sewerage Commission has been requested to confer with the new commission that there may be as close connection in plan, work, records and reports as possible.

FIRE AND WATER

Water Works for Marceline, Mo.

By L. A. Nickell, Superintendent.

No matter how large or how small the municipal plant, it should be operated with the greatest efficiency it is possible to obtain. Efficiency and economy are not necessarily the same, altho efficiency is essential to economy.

In our municipal electric light and water works plant, careful attention is given to both fixed charges and operating costs. From the very start, careful study has been made of present and probable future operating conditions. The cost of labor, fuel and supplies is carefully considered. The interest rate on loans, the efficiency and durability of the machinery, the load fluctuations, the character of the service, the probability of proper handling and many other things must be taken into account before a rational decision as to what is the most economical plant can be made. Most of these considerations apply equally well in the choice of additional equipment, although other matters such as the space available, the character of the machinery already installed, the question of permanence of supply, the proposed addition of a water purification plant or the serious depreciatiou of the present plant, which will necessitate comptele reconstruction in the near future, and the amount of available funds may have a deciding influence.

To obtain satisfactory results it is necessary that each and every part of the equipment be maintained at all times in the best possible physical condition. In the first place, everything should be kept scrupulously clean. The operators themselves are not to be excused from this requirement. Dirt is a visible sign of inattention and where there is carelessness in this particular it generally permeates the whole station.

Cost records should be kept. They should take into account not only cash expenditures, but the actual cost of maintaining the plant for definite periods of time, which is an entirely different matter. The records should carry enough detail to enable the superintendent to determine at once any variation from standards or unusual expense in the upkeep of any part of the machinery. Less labor is involved with intelligent, efficient operation than with careless, inefficient operation. There is less oil to handle, less damage to machinery, less repair work to be done, less new machinery to be bought. The only increase involved is that of brain energy, the proper exercise of which makes better executives and better operatives.

Following are a few terse statements relative to our plant, which may prove of interest:

Water is fed to our pumps under a head of about 10 feet, thus insuring a plentiful supply. Pump house is located back of and just below the reserve dam. Reservoir is 2 miles from town, capacity, 115,000,000 gallons and 1¾ miles long by about 1,000 feet wide at dam.

The pumps are started from the electric light station, the water being by-passed until the motors are under full speed, when they are allowed to pump under full pressure, which is about 170 feet head.

One 60,000 gallon tank is 120 feet high, the pump house being 50 feet lower than the base of the standpipe.

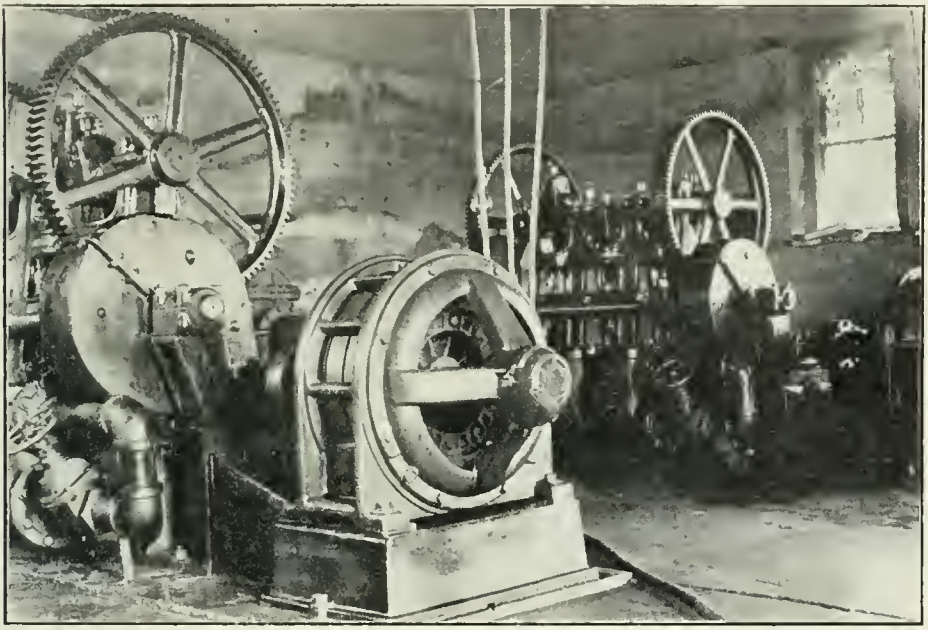
Thirty kw. is about the average consumption of power for pumping, the average number of hours pumped per day is now ahout 15 hours, and capacity of pumps about 34,000 gallons per hour each.

The transmission line from the power house to the water pump house consists of three bare hard-drawn copper wires No. 6, on 30-foot wood poles.

A private telephone line connects the power house with the pump house, the wires being run on the same poles with the power wires.

Our 85-h.p. Fairbanks, Morse & Co. producer-gas engine is belted to a 624 kw. 3-phase, 2,300 volt, 60-cycle generator. This engine, started by a 7½-h.p. 3-phase electric motor air compressor, is run almost continuously. For the producer-gas

engine we use Pennsylvania anthracite pea coal at a cost of $7.90 per ton in the bin, and for the steam engine we use bituminous coal from the Marceline mines at a cost of $2.75 per ton, this being a very good grade of coal for boiler purposes.



INTERIOR *of Marseline, Mo., Water Works, showing producer-gas engine connected to generator.*

The producer-gas engine produces a kw. hr. on about 3 pounds of hard coal and the steam engine one kw. hr. on about 12 pounds of soft coal.

Advantages of Meterage System

By A. J. O'Keefe, Administrative Superintendent Water Works Department, Cincinnati, Ohio.

It is highly important to reflect that a just conservation of a water supply can only be effected thru meters, the use of which will soon be general in cities of the United States where the population justifies the supply being furnished by the community.

In the year 1911 there were in use thruout the country 2,500,000 meters, one-fourth of which were installed in the latter year. There should be no reasonable objection to their use, as it is now conceded that wherever introduced they prove mutually beneficial to the city and consumer. It is the consensus of opinion of those interested in municipal water plants that meters are the most potent, if not the only, factor in the prevention of waste, and at the same time result in reduced water rents to the consumer who confines himself to a careful use of the supply.

In August of 1912 it was found by this department that there were 2,650 commercial and manufacturing plants still on a flat rate basis, and it was decided to notify them to have meters installed. Little or no opposition has been manifested, as it seems to be the prevailing opinion that it is the only just and correct method of charging for water.

After all the business premises shall have attached meters all residences, both in the high and low service districts, will be notified to make meter connection likewise, and should no delay be experienced, it may reasonably be expected that the close of the year 1914 will find all hydrant branch services metered. When this is done the vast amount of water that is estimated as wasted annually through defective plumbing, namely, about 30 per cent., will be saved.

During the year 1912 our total pumpage was 18,822,797,871 gallons; maximum consumption (January), 1,648,383,209 gallons; minimum consumption (November), 1,436,320,447 gallons; average daily consumption, 51,372,859 gallons.

Of the above amount 2,439,186,632 gallons passed through 19,473 domestic

meters, representing practically 50,630 families, or an average to each service of this kind of 1.70 families, showing a daily consumption of 33 gallons per capita. The 29,931 survey premises represent, at 1.70 families to each premise, 50,782 families, or a total for both meter and survey premises of 101,412 families. The total revenue received from the metered premises was $724,102.25, an increase for 1912 of $38,034.03, while the survey premises yielded (inclusive of contract payments for main line extensions) $375,806.84, a decrease of $27,355.10. It is estimated tha 32.70 per cent. of all water consumed was used for survey premises and in construction work, etc., or a total of 6,153,931,548 gallons.

—Net Increase from Water Rents—

Increase, meter service		$38,034.03
Increase, improvement division		393.38
		$39,427.41
—Loss—		
Decrease in survey service	$27,355.10	
Decrease in elevator service	2,984.63	
		30,339.73
Net increase		$8,087.68

It would be difficult, if not impossible, for us to determine how much water has been wasted on unmetered premises while same were on a flat rate basis, but all water works engineers are conversant with its enormity.

UNMETERED *consumption results in wastes amounting to from 60 to 25 per cent.*

Competent authorities estimate that from 25 to 60 per cent. of all water supplied in an unmetered plant is absolutely wasted. It is apparent that under such conditions it is an impossibility to operate the water works at the minimum cost. The financial loss to the city or company is in proportion to the amount of water waste. Officials who do not realize how costly this is to a city often conclude that the remedy for water shortage caused by waste is enlargement of the water works. This is an absolute error. *Enlarged capacity encourages greater waste.* The only permanent and reliable remedy for this condition is the universal water meter system.

Some of the chief causes of water waste are: The flat or schedule method of selling water. Leaks in pipes or fixtures. Disordered flush-tanks in water closets. Opening faucets to prevent freezing, etc. Allowing water to run through hose indefinitely. Wasting water washing vehicles, sidewalks, etc. Continuous flow of water at troughs and fountains. Defective circulation in hot water systems. Testing rough plumbing in new buildings.

The water meter is the only reliable and efficient device capable of arresting water waste, detecting unsound plumbing, guaranteeing the city or company full payment for water furnished, preventing disputes with consumers by showing at all times the correct quantity of water furnished.

IN *order to insure the highest mechanical efficiency quality must be given first consideration.*

We advise that quality in any article means durability and particularly in meters. The first cost is of small moment compared with efficiency. Many water works officials know from experience what we have been constantly emphasizing for years, that the lowest priced meters you can buy are the most expensive meters to use. The very nature of the service demanded of the water meter should readily suggest to any purchaser that the highest quality is always the most dependable. To produce a meter of the highest quality is a more expensive operation than to make an inferior article.

Our total net receipts from water rents during the year 1912 were $1,155,892.02, distributed as follows: Metered premises, $724,102.25; survey, $375,806.84; elevators, $29,940.72; improvement division, $26,042.21, showing an increase over the previous year of $8,087.68. While this increase did not equal the average increase of the past three years, it is a source of some gratification, in view of the fact that this result was entirely unexpected in a presidential year. In other words, 62.64 per cent. of the entire revenue from water rents has been derived from the metered premises, while the survey premises yielded 32.51 per cent., the balance, 4.85 per cent., being obtained from elevators and the improvement division.

Our consumption of water by meter from December 20, 1911, to November 20, 1912, was as follows:

		Gallons.
19,473	Domestic meters	2,439,186,832
2,104	Commercial and manufacturing meters	4,528,025,925
194	Contract meters	221,493,883
43	Charity meters	96,578,250
107	Free meters	178,342,845
21,921		7,263,627,735

We have installed and have in service a considerable number of American and Ni-

agara meters, furnished by the Buffalo Meter Company, which have been in service for a considerable period, and during 1912 51 new ones were attached. Of the 2,136 old meters removed and repaired during 1912 only 34 were of this make, which were furnished by the Buffalo Meter Company.

During the year 1912 we installed 4,120 meters, 2,119 on old branches, 1,799 on new branches and 202 renewed; 2,600 of the above total were attached from August to December, 1912.

The following is a record of the number of meters in service at the close of the year 1912:

Domestic Meters—	
Active	19,625
Continued	86
Day bills	1,820
New and not read	199
Commercial Meters—	
Active	2,529
Day bills	142
Continued	28
New and not read	13
Charity Meters—	
Active	49
Day bills	3
Continued	2
Contract Meters—	
Active	191
Not read	4
Free meters	108
Fire meters (not read)	17
Total meters in service December 31, 1912	24,812

Automatic sprinklers are not allowed unless meters are attached to the premises, and it is our opinion that a similar regulation should be passed by every municipality.

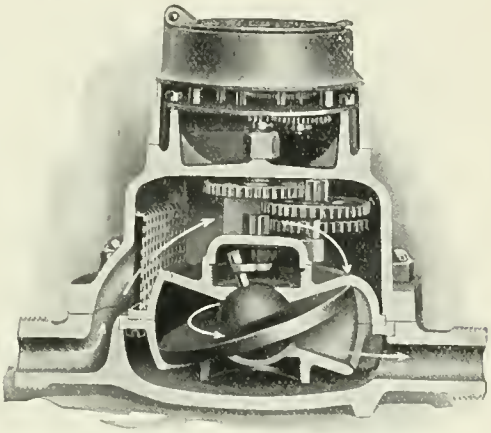
Whenever the rules and regulations of this department are abused by parties not on a metered service we insist on meter installation within fifteen days of notice or turn off the water, and same is in no case again turned on until the meter is installed.

We do not permit any person on unmetered service to sprinkle any lot, street or sidewalk between the hours of 8 o'clock a. m. and 5 o'clock p. m., nor more than two hours in any day, and it is our opinion that a similar regulation, strictly enforced, would greatly assist many municipalities in putting their water privileges on a meter basis, as it is now universally believed that the meter system is the only just and scientific method of charging for water consumption.

Under the new rules of this department, effective January 1 of this year, a maximum amount of water is allowed to the city departments, public buildings, schools, hospitals, charitable institutions, etc. Any consumption greater than the amount fixed by the rules is charged for at regular meter rates.

On all metered services the charge for water registered by meter is 8 cents per 100 cubic feet, with the provision that no bill will be rendered for less than 30 cents per month. Where consumption exceeds the amount covered by the minimum charge, the meter rate is now charged according to the consumption registered by the meter.

The owner of premises supplied thru meter is now held responsible for all water registered by it and no reduction in bills is allowed when a part of the water has been used by a contractor or any other person, tho he has paid for a permit at our office, or on account of leaks.



SECTIONAL *view of meter in general use by Cincinnati Water Works.*

On all metered service outside the city of Cincinnati the charge for water registration by meter is now 5.8 cents per 100 cubic feet; and no bill is rendered for less than 45 cents per month. Incorporated villages are now supplied only under contract, and on a metered service.

We insist that all meters must be watertight and must register within the following percentage of the actual water passed through them, either with full flow or with ⅛-inch opening:

½-in., ¾-in., ¾-in. and 1-in. meters.	1½%
1½-in. and 2-in. meters	2 %
3-in. meters	4 %
3-in. meters	3 %
4-in. meters	4 %
6-in. meters	5 %

We insist that all meters which have been in service a reasonable time must register within the following percentage of the actual water passed thru them.

either with full flow or with ⅛-in. opening:

½-in., ⅝-in., ¾-in. and1-in. meters.	3½%
1½-in. and 2-in. meters.....	4 %
3-in. meters	5 %
4-in. meters	6 %
6-in. meters	7 %

High Pressure Streams Used in War Against Tussock Moth

The shade trees of Waukegan, Ill. are endangered by the tussock moth. This is not the first invasion Waukegan has had, but it promises to be the most disastrous.

These moths began to make their appearance a month ago and already many trees appear to be almost alive with them. Where they came from nobody seems to know. Local people who have had experience with them in the past are doing all within their power to destroy the pests, but up to the present time their efforts have not been productive of very good results. All kinds of chemicals that will not injure the trees and still should have an effect on the moths have been tried but without much success.

Now an appeal is to be made that the city save the shade trees of the city by turning streams of water on them. In the past in Waukegan, as well as in other cities, it has been found that the very best way to get rid of the moths was to have water directed against the trees from a high pressure hose.

In other years the members of the fire or street department have performed this task and the results have been fully satisfactory.

The plan followed in the past was to have people who were bothered with the moths leave their names and addresses with the city officials and the city employes were sent to the location with a section of fire hose. This hose was attached to a fire plug and the water was directed against the trees with great force. This seems to loosen the moths from their position and in this manner the trees are saved. Unless something is done soon hundreds of the finest shade trees in the city will be ruined. Prompt action is all that will save them.

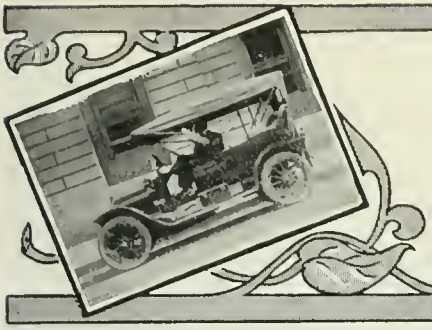
Electroliers Mark Location of Fire Boxes

The ornamental cluster lights on Broadway, Los Angeles, Caldfornia, now serve to guide the man who is looking for a fire alarm box. A broad red stripe with the words "FIRE ALARM" is painted on the central globe of the cluster, upon the electrolier which stands near a fire alarm box. The sign is conspicuous by day as well as by night and should be of considerable value in fixing the location of the signal stations in the memory of the passersby.

ORNAMENTAL *Lighting Posts give prominence to fire box locations.*

Fire Protection for Government Records

In order to protect the valuable records of the Government from danger by fire Congress has made an appropriation for the installation of a modern system of auxiliary fire protection for three of the largest buildings occupied by the Department of the Interior in the city of Washington. A committee has been appointed to investigate the relative merits of systems adaptable to the buildings of the Department and to prepare plans and specifications. All communications regarding the subject should be addressed to the chief clerk of the Interior Department, Washington, D. C.



Automobiles in Municipal Service

Motor Fire Insurance Patrols

By E. T. Shepherd, Superintendent Chicago Fire Insurance Patrol, Chicago, Ill.

OUR experience with motor-driven apparatus has been so satisfactory and the time is not far distant when the sight of high-stepping steeds will be a memory only. We quite recently completed new headquarters in which no provision was made for horses, and the same is true of the house which we are now building on Green street.

The nature of our work is such that it is urgent that we reach all fires in the shortest possible time. The number of alarms and calls is constantly increasing, but we have been able to increase the territory of those houses in which we have motor apparatus fully 33 1/3 per cent. since its installation. In other words, we are not only covering more territory with the same number of men, but we are doing so much more efficiently and economically.

During the past year our eight companies and details answered 2,443 alarms, 215 second alarms, 101 third alarms, 30 fourth alarms, 3,771 still alarms and 2,152 stills to patrols. During this same period our eight companies attended 304 fires in other companies' districts, 5,857 alarms in stills, 71 special calls, spreading 18,413 covers. These same companies spent 3,763 hours in covering roofs, using 680 chemicals and 179 sprinkler heads. These same companies during the year ending December 31, 1912, spent 4.514½ hours in actual service.

Our six White combination chemical and five White patrol trucks enabled us to continually increase our efficiency, as we are not only able to reduce the running time for the various alarm districts but are enabled to cover fully one-third more territory at 33 1-3 per cent. less expense than would be requisite in case same companies had only horse-drawn equipment. Our trucks, which are furnished us by the White Company of Cleveland, Ohio, have the full and standard equipment of chemical tanks, hooks, ladders, tarpaulins, etc. We have just ordered four more of these trucks and on their arrival, which we anticipate will be in about ninety days, the Chicago Fire Insurance Patrol will be motorized throughout and we believe will enjoy the distinction of being the first large fire insurance patrol to be so equipped.

We keep an accurate monthly record of each company's motor expense. These monthly automobile reports are made out on each car and give itemized account of number of runs, mileage, gasoline used, oil and grease used, etc. Ample space is left for remarks on each of these monthly automobile reports to be signed by the captain of each company.

An accurate idea as to the work done by these trucks may be gained from the fact that truck No. 5 during the month of January, 1913, made 73 runs, totaling 115.7 miles, at a cost of $14.02. In this cost item are included details of cost of gasoline, oil, tire repairs, grease, etc. During the month of January truck No. 6 made 74 runs, totaling 151 miles, at a cost of $18.00. During this same month truck No. 3 made 104 runs, a distance of 236 miles, at a cost of $19.00. During the month of February truck No. 5 made 108 runs, totaling 178 miles, at a cost of $20.00. During this same month truck No. 6 made 108 runs, a distance of 318 miles, at a cost of $12.52. During the month of March trucks Nos. 3, 5, 6 and 7 made the following record:

Truck 3—91 runs, 225 miles, cost, $13.70
Truck 5—71 runs, 128.6 miles, cost, 13.46
Truck 6—58 runs, 126 miles, cost, 13.60
Truck 7—66 runs, 180.6 miles, cost, 9.34

Motor-driven combination patrol trucks are not subject to extremes in weather conditions. They travel right along thru snow or over icy streets and roads as well as make record time on the hottest summer days.

There are certain seasons when all of our companies are worked to the limit, and then there are slack periods, but in each case the motor-driven combination chemical and patrol truck proves its ad-

vantage over horses. The limit of horse endurance is only a little more than the average amount of work which he performs daily. It is impossible to speed horse-drawn apparatus over a certain limit or work it overtime as much as is often required. Motor-driven apparatus renders unnecessary hiring of additional horses at a heavy expense to help out during rush periods. It costs as much to feed a horse when he is idle as when he is working. The combination chemical and patrol truck works as many hours overtime as is required and it will travel the last hour just as fast as the first. It does not get tired out, nor does it require the attention of attendants while the fire is in progress.

The following figures may be of interest in that they give an accurate idea of the work performed by the different companies during the past year:

WHITE MOTOR PATROL TRUCK, *in use by Chicago Fire Insurance Patrol.*

The total insurance involved in fires during 1912 in Chicago was $50,490,166.32, the total loss to insurance was $6,163,792.14, and the excess of insurance over loss was $44,226,374.18.

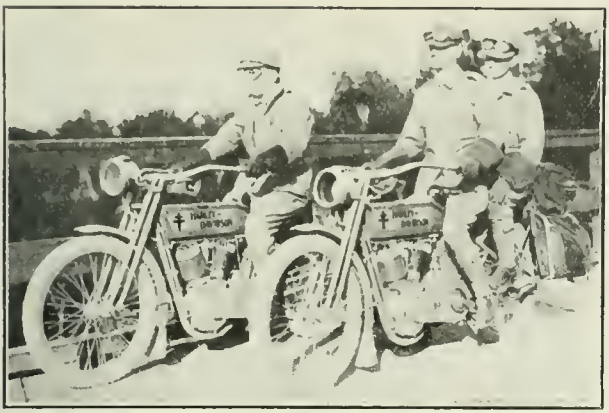
The following is a summary of insurance and loss on buildings in the city of Chicago for the year 1912:

Insurance on buildings	$29,685,685.59
Insurance on contents	20,804,480.73
Loss on buildings	2,840,511.69
Loss on contents	3,323,780.45

Insurance losses and percentages in the city of Chicago for a period of 34 years, 1879 to 1912, is as follows:

Insurance on buildings	$509,486,059.00
Loss on buildings	37,914,362.00
Insurance on contents	390,364,863.00
Loss on contents	79,830,200.00
Ratio on buildings	7.44
Ratio on contents	20.45

Companies.	Sprinkler heads used.	Covers spread.	Runs.	Fires.	Duration of service. Hours.	Minutes.
No. 1	56	466	165	9	87	30
No. 2	32	104	54	7	35	50
No. 3	6	9	30	2	12	..
No. 5	96	147	28	2	19	5
No. 7	1	9	39	..	11	..
No. 8	10	121	64	..	28	10
Total	201	856	380	20	193	35



HEALTH CRUSADERS *in Wisconsin. Harley-Davidson motorcycle carries stereopticon for lectures, camping outfit for party, signs to post, and two men.*

Motorcycles Used by the Wisconsin Anti-Tuberculosis Association

By Otto F. Bradley, Assistant Secretary.

As a result of a experiment made in Wisconsin last summer motor cycles are employed in the Badger State to good advantage in the crusade against the great white plague. A rural campaign has been put on by the use of a motorcycle, which is perhaps the most unique venture of its kind ever attempted.

Two health crusaders, a lecturer and an assistant, work together. They would compare with a knight and his squire of olden times, except that they both ride on one steed, a gasoline steed, and differ from the knight of old in that they are independent of the hospitality of castles or monasteries, for they carry a complete camping equipment, sleeping out of doors and doing their own cooking.

The work consists of placarding the country with health signs and giving talks at creameries, country cross roads and small villages, wherever a crowd can be assembled. A village is usually chosen for an illustrated lecture in the evening. In working the surrounding country during the daytime the health evangelists advertise the evening lecture.

Stereopticon views are a feature of this talk, which is usually given out of doors. The stereopticon is operated from the luggage carrier of the motorcycle, being connected with the gas tank, which also supplies the headlight.

The expense of this work is comparatively small, since hotel bills are eliminated. The ground can be covered rapidly and no time is wasted waiting for trains. As many people can be reached in the country in this manner as by the ordinary lecture tour through cities. After their opening in the fall a talk in each rural school will be made part of the program. This work can be carried on about six months out of the year.

Motor Driven Street Sweeper Used in Oakland, Cal.

Oakland's streets are now being swept by a motor-driven sanitary street-sweeping machine. It was invented and built by the Sanitary Street Sweeping Co., San Francisco, Cal.

This machine sweeps the streets dry and takes up the material as it goes along and removes the dust. In doing this it does something that no other device yet invented is able to accomplish. It is an improvement on hand sweeping since it

POSTING ANTI-TUBERCULOSIS SIGNS *in Wisconsin. Motorcycle carries two men and their educational outfit.*

does not raise any dust, but lifts all the dust from the street under a cover which closes tightly around the broom and deposits it in boxes inside the machine.

The machine makes very little noise and sweeps in the daylight without interfering in any way with traffic or the comfort and convenience of pedestrians. It does not take up any more room than an ordinary truck, makes less noise and raises no dust whatever. It solves the dust problem in street cleaning completely and puts an end to the menace and nuisance of dust in the crowded thorofares.

The machine is unique in that one gas engine drives the truck and the sweeping machinery. Its speed is regulated to a nicety, ranging from a mile and three-quarters to eight and a half miles an hour, working as steady as a clock. One of its chief recommendations is that it cleans the dust and fine refuse finding a lodgment in the slots of car tracks. It will take up such heavy things as horseshoes and pieces of broken stone and leaves the street as clean as a floor and as free from dust as a parlor.

This machine can be seen sweeping in the heart of the business district any time during the day.

Experts from San Francisco, Los Angeles and other Pacific Coast cities have been watching its operation and as soon as new machines can be constructed, it will be utilized in San Francisco. Medical men who have taken note of its operation unite in saying that it is sanitary.

This machine operates upon the principle of both the ordinary carpet sweeper and the vacuum carpet cleaner; that is, the rear part of the machine contains a revolving brush that sweeps the heavier articles from the street to a conveyer, which deposits them in a series of tanks, and two fans, immediately behind and above the brush, suck up the dust and force it thru cloth tubes to metal tanks in the forward part of the machine. The machinery is driven by the gas engine which is used to propel the vehicle.

On business streets containing large quantities of dirt, this machine will sweep a strip 8 feet in width and five miles in length per hour. On residence streets, it will sweep eight miles per hour.

The right hand side of the machine shows a rope drive, the lower sheave is the drive, the upper one drives the fans, two in number, while the forward one drives the draper that carries the heavy material into the machine; the center sheave is a tightener to take up any slack in the rope.

Immediately in the front of the sweeper will be seen two doors. This is the receptacle for carrying the dirt, in which are placed twenty-three tanks made of galvanized iron, seventeen of which carry the coarser material, while the forward row of six tanks carry the fine dust, 3½ yards in cubic contents.

When the sweeper has picked up its load, the tanks are removed to a carry-away wagon. The sweeper is then filled with empty tanks, and goes about its sweeping, while the refuse is hauled to the dumps.

Looking at the left hand side of the machine, the broom drive is seen with its rope drive and tightener. In the forward part of the sweeper will be seen the device for removing the dust from the bottom of the collector to the front of the sweeper, and depositing it in the front row of tanks.

In the rear view of the sweeper is shown the broom case open; when in operation this case is closed. You will also notice that back of the broom case, and next to the street surface, an opening is left, 3 inches wide and 8½ feet long. This is for the free inlet of air, the broom being of open type, the fans draw into the sweeper all dust raised by the broom. The heavier particles are dropped onto the draper, while the lighter particles are passed thru the two fans, and in turn are blown into the top of the sweeper. This space is 8 inches deep, and filled with a plate on its lower side containing 525 4-inch tubes, made of canton flannel, about 1,400 square feet of surface in the tubes or stockings. The air being steadily forced in one direction, down the tubes, steadily escapes thru the cloth, and leaves the sweeper perfectly clean thru the louvers on each side.

Regardless of the quantity of dirt or dust on the surface, we remove it without wetting the surface of the roadway, and without making any dust.

The fans, two in number, run at a speed of 450 revolutions per minute. The sweeper runs over the surface at speeds of from 2½ miles per hour for extremely dirty streets, to 5 miles for ordinary business streets. Eight miles per hour can be maintained on residence streets.

W. W. Thompson, assistant deputy superintendent of streets, city of Oakland, Cal., favors us with report of resweeping certain streets with above machine as follows:

Resweeping Clay street, from the south line of Third street to the south line of Seventh street:

Length, 1,040.5 feet; width, 52.6 feet; area in yards, 6,080. Starting time, 6:38 a. m.; finishing time, 6.58 a. m. Dust, 97 pounds; 1.89 cubic feet. Street sweepings, 112 pounds; 2.77 cubic feet. Gutter sweepings, 200 pounds; 5.24 cubic feet.

Resweeping Twenty-fifth street, from the east line of Grove street to the west line of Telegraph avenue:

Length, 1,023 feet; width, 31.9 feet; area in yards, 3,625.9 square yards. Starting time, 7:37 a. m.; finishing time, 7:44 a. m. Dust, 72 pounds; 1.44 cubic feet. Street sweepings, 24 pounds; 1 cubic foot. Gutter sweepings, 91 pounds; 3.67 cubic feet.

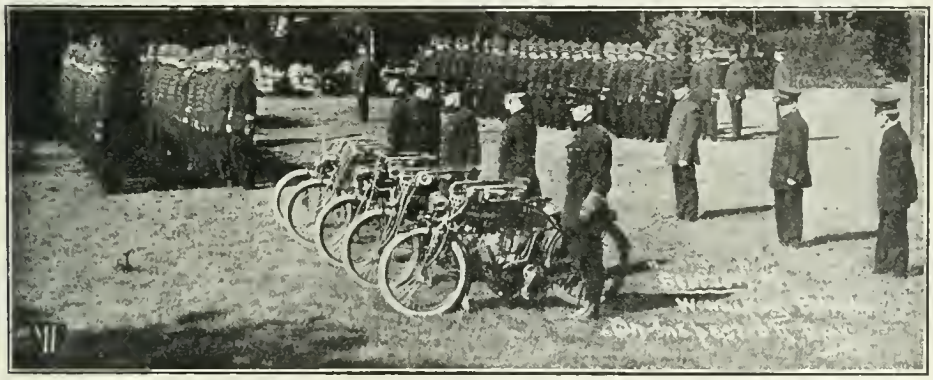
Resweeping Piedmont avenue, from the east line of Broadway to the north line of Echo avenue:

Length, 4,357 feet; width, 52 feet; area in yards, 25,173.6 square yards. Starting time, 8:15 a. m.; finishing time, 9:13 a. m. Dust, 69 pounds; 1.44 cubic feet. Street sweepings, 383 pounds; 8.31 cubic feet. Gutter sweepings, 335 pounds; 13.85 cubic feet.

Total clean-up, 1½ yards of sweepings. Sweeping time, 1 hour, 25 minutes.

In 1905 Sergeant Benjamin Mallam of the Traffic Squad of the New York Police Department organized the first motorcycle police detail in this country, and its success became immediate. More speed-law violators were caught that summer than had been apprehended for several years previously by the mounted horse and bicycle squads, for it was impossible to shake the little two-wheel scouts. Since Gotham did the pioneering in this field over 400 police departments in this country and Canada have adopted the motorcycle.

It is difficult to think of a prominent city which does not boast of at least one motorcycle officer and this minimum is the exception, for almost invariably, after one machine is in service a few months it



MOTORCYCLE SQUAD, *Winnipeg, Man., uses twin-cylinder Indian machines.*

The Gasoline Arm of the Law

It is not enough to enact an ordinance, and trust to its observance, for if it cannot be enforced it is valueless. When the automobile became a reality on our highways, its excessive speed and the abuse of that speed naturally forced the drafting of regulations to restrict the speed to a safe minimum. However, if the motorcycle had not trailed along in the shadow of the motor car, the speed laws would have been a huge farce in-so-far as concerned their enforcement.

It is unanimously conceded by police authorities that the motorcycle put sharp teeth in the speed laws and made them respected by automobilists. Motorists have brushed up against motorcycles on the road, and being fully cognizant of their ground-covering abilities it is natural that the average car owner will have respect for the speed laws of a town where he sees a blue coat on a motorcycle now and then. If the officer is a capable rider it is folly to thrown down the gauntlet to him for the chase will be short and swift and will end in court.

justifies the commissioning of others. Not only do city departments consider the motorcycle one of their best weapons, but sheriffs, deputies, constables and other officers of the law find it invaluable in the performance of their duties.

Among the prominent users of motorcycles in large numbers may be mentioned New York, Philadelphia, San Francisco, Detroit, Chicago, Toledo, Newark, Los Angeles, Houston, Rochester, Buffalo, Cleveland, Dayton, Indianapolis, Denver, Brooklyn, Hudson County, N. J., Nassau County N. Y., and San Jose. New York and Philadelphia have over fifty machines each in service.

In its fight for recognition from police departments the motorcycle has had to show a low upkeep cost and it has put up some wonderful figures. For example the scorcher squad of Detroit, which has to keep an eye on the road-burning testers, and overhaul them when they break over the traces, ran six machines over 30,000 miles in eight months for $13.13, or an average of $2.18 per machine. Officer D. W. Ward, of the Memphis, Tenn., department drove his machine over 1,900

miles without spending a cent for repairs except $2.80 to cover damages due to accidents. Officer G. W. Seaman, of the Nassau County, N. Y., Boulevard Squad, made 199 arrests in a season, and secured 187 convictions which netted fines amounting to $3,240.

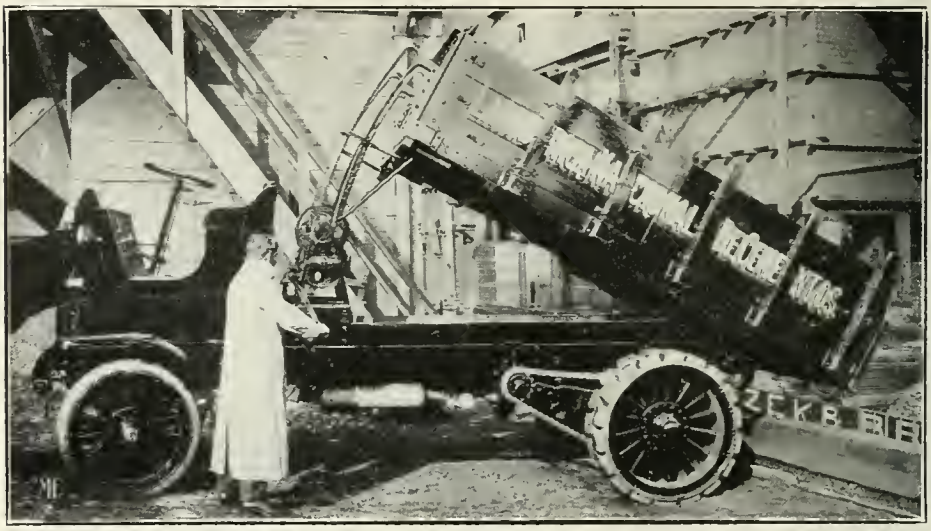
One of the strongest advocates of motorcycles for police work is Mayor E. C. Rice, of Coffeyville, Kan., who says: "Last winter we purchased a twin cylinder seven horsepower motorcycle for the police department of this city. During that time it has made 8,000 miles and is one of the best investments the city has ever made. I cannot see how we did without it so long. It has been the means of running down thieves and hold-up men which we could not possibly have captured without it."

Presented in concrete form, the motorcycle is particularly well qualified for police work because it is always ready for instant service, its endurance for continuous hard service will exceed that of horse or human, its lighting get-away for emergencies, its ability to cover large territory rapidly, its ease of handling in congested traffic and its economy of operation. There is no question but that the motorcycle has become a permanent institution in police circles and more machines are being commissioned every day to enforce the majesty of the law.

Big Motor Truck for Venezuela

The accompanying photograph shows a powerful contractor's special dumping body truck owned by the government of Venezuela for the hauling of crushed rock, etc.

This truck of 5 tons capacity and costing approximately $5,000 is fitted with a powerful type of special truck motor, designed with a view to good results in strength, economy and sound service and has four cylinders, cast in pairs, 4½-inch bore, 6¾-inch stroke, giving great power at slow speed. It is controlled in speed by an automatic governor restricting the speed of the truck to ten miles per hour.



FIVE-TON *Sternberg truck equipped with special dumping body.*

The transmission is of unusual size and strength in proportion to the great power of the engine. It is of heavy, compact, individual clutch type, with 1¼-inch face gears always in mesh, making it impossible to strip gears in changing of speed. The frame is pressed steel with solid oak lining, of great resilience, and insured against crystalization. The steel and oak are bolted together as one piece and no rivets are employed. The axles are solid nickel steel forgings, and heat treated, provided with large taper roller bearings on which accurate adjustment may be made for wear.

This truck is equipped with a large and efficient vertical tube radiator, encased in a leather lined shell, suspended on springs. The motor is one of the easiest cooled and best running under the most severe conditions of hot climates. It is of unusual efficiency for hard grades, under heavy load. The standard equipment is complete and in harmony with the high character of the truck. It is fitted with electric side and tail lights, Klaxonet electric horn, hub odometer, etc., and was furnished the Venezulan government by Sternberg Mfg. Co., West Allis, Wisconsin.

PERSONAL

Technical Schools

"Reinforced Concrete Wall Footings and Column Footings," by Arthur N. Talbot, has just been issued as Bulletin No. 67 of the Experiment Station of the University of Illinois. It gives the results of tests to destruction of a number of full-sized reinforced concrete wall footings and column footings. The tests give the first experimental data of the action of structural footings of this kind under conditions approximating those which exist in actual structures. The results of the tests are utilized in the discussion of formulas and principles for the design of reinforced concrete wall footings and column footings.

Technical Associations

The Mississippi River Levee Association, Memphis, Tenn., is circulating pamphlets arguing that the protection from overflow and reclamation of 30,000 square miles of alluvial lands in the six states on the lower Mississippi river is really a national work since the waters from 31 states help to produce the floods. John A. Fox, M. Am. Soc. C. E., Scimitar Building, Memphis, is secretary-manager.

The American section of the Permanent International Association of Navigation Congresses is in charge of Lt.-Col. J. C. Sanford, Corps of Engineers, U. S. Army, as secretary, with office in the old custom house, Detroit, Mich., who is distributing evidence of the value of membership in the large and influential organization.

The National Association of Cement Users, the National Association of Sand and Gravel Producers, the National Conference on Concrete Roads Building, the Interstate Cement Tile Manufacturers' Association, the Illinois Lumber and Builders' Supply Dealers Association and the Illinois Association of Municipal Contractors will hold their 1914 meetings in connection with the Seventh Chicago cement show between Feb. 12 and 21, 1914.

The Illuminating Engineering Society will hold its next convention in Pittsburg September 22-26.

The Central States Water Works Association will hold its 17th convention at Breakers Hotel, Cedar Point on Lake Erie, August 26-28. R. P. Bricker, secretary, Shelby, O.

The American Mine Safety Association will meet in Pittsburg, Pa., September 22-24.

Personal Notes

W. H. Metcalf, of Metcalf & Wiggins, civil engineers, Los Angeles, Cal., has been appointed civil engineer of San Gabriel, Cal.

H. F. Meryweather has been appointed city engineer and member of the Board of Public Works in Denver, Colo., by J. B. Hunter, the former city engineer, who is the first commissioner of improvements and president of the Board of Public Works elected under the new commission form of government. Mr. Meryweather has been in the City Engineer's Department for thirty-three years and chief assistant engineer in charge of sewers. W. A. Sheriff, commissioner of highways, is appointed as the third member of the board.

W. Noble Twelvetrees, who has been one of the most prominent advocates of reinforced concrete in England, which country has been somewhat backward in adopting the new material, has been placed in charge of the editorial department of Ferro-Concrete, the English monthly review of Mouchel-Hennebique construction.

Edward L. Lake, formerly in charge of the electrical division of Stone and Webster, Boston, will hereafter represent that engineering corporation in Chicago, with offices in the First National Bank Building.

Theodore Hardee, the newly appointed chief of the Department of Liberal Arts of the Panama-Pacific International Exposition to be held in San Francisco in

W. A. Royce has been appointed city engineer of Traverse City, Mich.

Robert J. Thomas, superintendent of water works at Lowell, Mass., and past president of the New England Water Works Association, is the new president of the American Water Works Association, having served as a vice president for four years.

Henry L. Bowlby, formerly state highway commissioner of Washington, has been appointed state highway commissioner of Oregon.

Alfred E. Roche has been appointed city engineer of Troy, N. Y.

ADD TECHNICAL ASSOCIATIONS

The National Old Trails Road Association, Judge J. M. Lowe, president, Kansas City, Mo., has become the National Old Trails Road Department of the National Highways Association, and will retain its headquarters in the Midland building, Kansas City, as a branch of the national body. The headquarters of the National Highways Asociation are at 18 Old Slip, New York City, with Charles Henry Davis, C. E., as president.

1915, calls attention to the advisability of early application for the limited free exhibit space assigned to the engineering and architectural professions in his department.

Publications Received

Trade Waste Waters, their nature and disposal. By J. Maclean Wilson, M. B. Sc., chief inspector, and H. T. Calvert, M. Sc., Ph. D., F. I. C., chief chemical assistant, West Riding of Yorkshire Rivers Board. Cloth, 331 pp., 74 illustrations, including 22 plates, $5. J. B. Lippincott Co., Philadelphia, Pa.

Principles of Irrigation Engineering, by Frederick Haynes Newell, Director, and Daniel William Murphy, engineer in charge of drainage, U. S. Reclamation Service. Cloth, 293 pp., 52 drawings, 64 illustrations, $3, net, postpaid. McGraw-Hill Book Co., New York.

The Civic League. The story of the year's work for St. Louis, Mo., 1912. Roger N. Baldwin, Secretary, 911 Locust street.

Portland Cement Materials and Industry in the United States. By Edwin C. Eckel and others. Paper, 401 pp. Bulletin 522 of U. S. Geological Survey, Washington, D. C.

Fourth and Fifth semi-annual reports of Sewage Disposal Commission of Fitchburg, Mass., covering year 1912. David A. Hartwell, Supt.

The Purification of Public Water Supplies. By Geo. A. Johnson. Paper, 84 pp. Water Supply Paper 315 of U. S. Geological Survey, Washington, D. C.

Development of the Modern Country Roadway. By Geo. C. Warren. Paper, 64 pp. Reprint from Journal of Am. Soc. of Eng. Contr. Warren Bros. Co., Boston, Mass.

Repair and Maintenance of Highways. By Laurence I. Hewes, chief of economics and maintenance. Paper, 71 pp. Bulletin 48 of Office of Public Roads, Washington, D. C.

Twentieth annual report of Bureau of Engineering, Department of Public Works, Buffalo, N. Y., for year ending June 30, 1912. Geo. H. Norton, deputy engineer commissioner.

Administrative Methods of the city government of Los Angeles, Cal. Report of a preliminary survey of certain city departments, made for the Municipal League of Los Angeles by the New York Bureau of Municipal Research. Paper, 27 pp.

Proceedings for 1912 of The Municipal Engineers of the City of New York. Cloth, 362 pp. Geo. A. Taber, secretary, 39 W. 39th street, New York City.

Report of proceedings of 9th annual meeting of American Wood Preservers' Association, 1913. Paper, 478 pp. F. J. Angier, secretary-treasurer. Baltimore, Md.

Annual report of city comptroller, W. C. Handy, of St. Paul, Minn. Cloth, 120 pp.

Mayor's Message and Municipal report of Portland, Oregon, for 1912. A. G. Rushlight, Mayor.

Fifty-sixth annual report of the Controller of Detroit, Mich., year ending June 30, 1912. David E. Heineman, controller.

The principal subjects in Lefax, for April, the collection of engineering data in card-index form, are cement and concrete, bridges, heating, lighting and sewage disposal, and standard tables. Standard Corporation, Penna Bldg., Philadelphia, Pa.

Seventh annual report of the Board of Water Supply of New York city for 1912, with report of chief engineer. J. Waldo Smith, chief engineer.

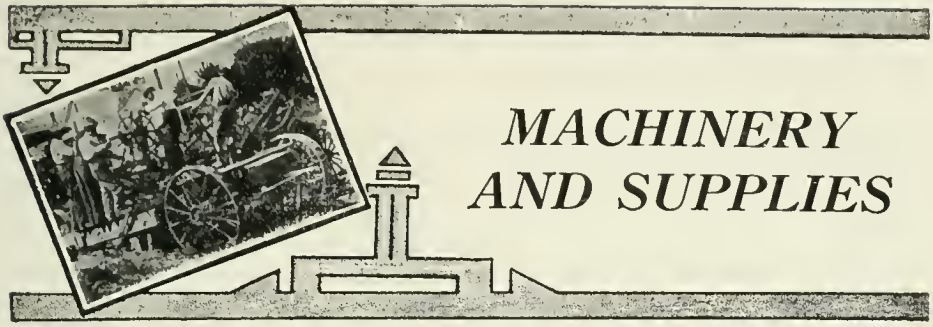
Annual report of Louisville, Ky., Water Co., for 1912. Theodore A. Leisen, chief engineer and superintendent.

Taschenbuch fuer Kanalisations—Ingenieure. By Dr. Ing. K. Imhoff. Cloth, 29pp. R. Oldenbourg, Munich and Berlin. D. Van Nostrand, importer.

Twentieth Annual Report of the Department of Public Works of Buffalo, N. Y., to June 30, 1912. Francis G. Ward, Commissioner. Paper, 1181 pp.

Report of Water, Light and Power Department of Austin, Tex., for 1912. E. C. Bartholomew, commissioner of public parks and property. Paper, 19 pp.

Forty-sixth Annual Report of Commissioner of Water Works of Erie, Pa., for 1912. E. W. Humphreys, superintendent. Paper, 69 pp.



MACHINERY AND SUPPLIES

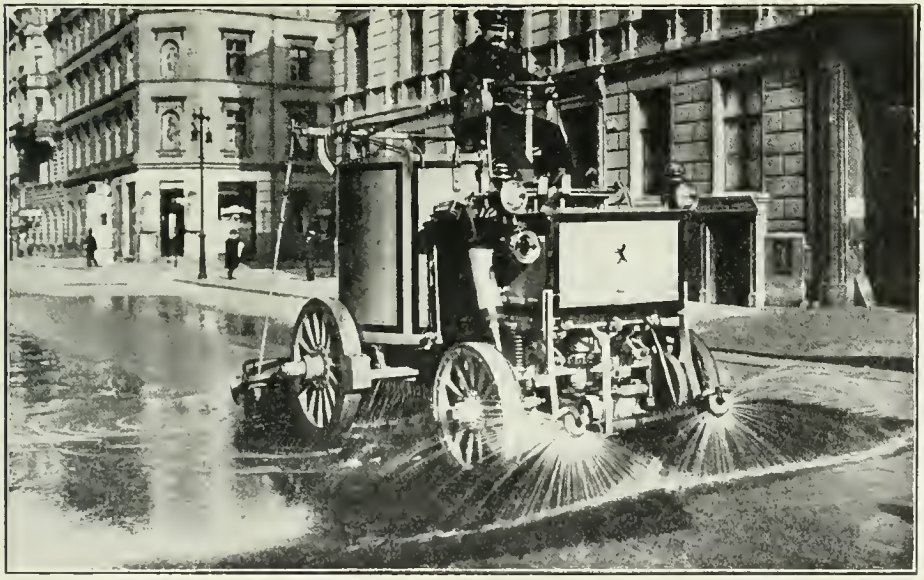
The Squeegee in Berlin.

Berlin, Germany, proper is a city of somewhat more than 2,000,000 population. The aggregate area of its streets regularly cleaned by the municipal street cleaning department was 8,235,620 square yards, and of its sidewalks regularly cleaned by the same department 5,143,096 square yards. Of this combined area of 13,378,716 square yards regularly cleaned, 8,841,831 square yards received daily cleaning. There are 4,056,373 square yards of stone and 3,658,109 square yards of asphalt pavement. The stone predominates in sidewalk paving and asphalt in the street paving.

The equipment of the street cleaning department includes, besides the appropriate supply of brooms, wooden and rubber scrapers, handcarts, etc., 111 sweeping machines, 16 scrubbing machines and 28 squeegee machines (combined sprinkling and scrubbing). In 1911-12 the sweeping machines used 1,599 roller brushes, a roller lasting on the average 21.4 work days.

Of the squeegee machines, 18 are motor driven and 10 horse drawn. The former are found to be the more efficient. In the course of the report under consideration 6 horse-drawn machines were equipped with motor drives and 6 additional motor machines were purchased for use in the current year. The type of motor machine used is manufactured by Hentschel & Cie, Zossenerstrasse 55, Berlin, and the Kindling Machinery Co., Milwaukee, Wis.

The department has published the fol-



ELECTRIC-DRIVEN SQUEEGEE *operated by the street cleaning department of Berlin, Germany.*

lowing figures bearing on the relative efficiency of motor and horse squeegee machines. The figures given represent the cost of operation per 8-hour work day:

Electric-driven squeegee machine—	
Driver's wage	$1.25
Electricity consumed (on an average 1.716 k.w. per hour at 3.808 cents per k.w.) in eight hours	.52
Insurance of accumulators against deterioration at $130.90 per year, or per day ($130.90÷300)	.44
Repairs, figured on basis of past experience	.63
Amortization, figured at 15 pct	1.49
More rapid consumption of rubber rollers, owing to higher speed	.08
Total	$4.41
Horse-drawn squeegee machine—	
Driver's wage	$1.12
Two horses, at $1.51 per horse	3.02
Repairs	.19
Amortization, figured at 10 pct	.24
Total	$4.57

Commenting on these figures, the department points out that an electric squeegee machine cleans in an hour 6,937 square yards of street surface, or in a day of eight hours, 55,496 square yards, at a cost, as shown, of $4.41, while a horse-drawn machine cleans in the same time only 44,013 square yards, at a cost of $4.57.

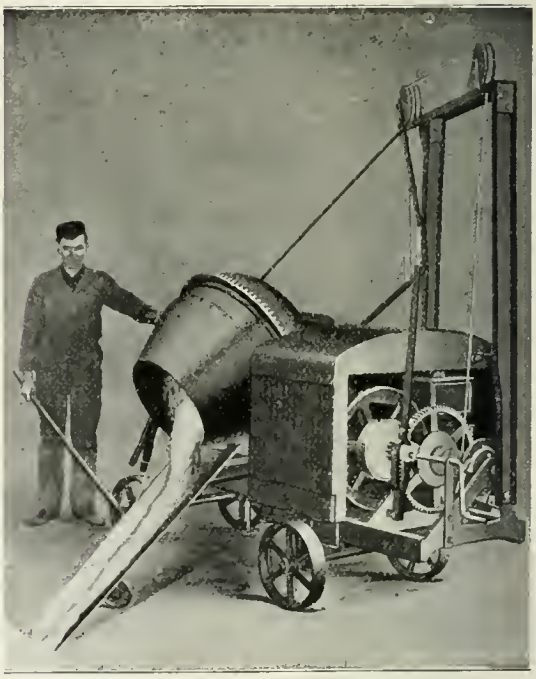
A Cement Grout Mixer.

By A. M. Anderson, Chicago.

Now that expansion and contraction joints have been provided for in brick pavements, as in all other pavements, the advantage of cement grout filler is the subject of discussion before many city councils and engineering bodies. While there is no donbt in my mind but that cement filler would now be universally used if proper data had been presented to engineers, one of the chief drawbacks to its use rests in the fact that until very recently no economical or satisfactory mechanical means of mixing or distributing had been devised.

The mixing and distributing of cement filler requires great care if the grout is to be uniform and therefore satisfactory. The use of four-legged unwieldly boxes and scoop shovels has never appealed to the engineer or contractor and in order to shorten this tedious operation, the mixing boxes have more than frequently been overturned on the pavement thus separating sand, cement and water and depositing same in different portions.

In cases where the box was properly emptied it has always been necessary to keep constantly stirring the grout in order to prevent a separation of the sand from the cement. This process of mixing and distributing cement filler for brick pavements has been slow and consequently expensive. It has been necessary to provide a mortar box for each 10 feet of width of street in order to fill the full width of the street with traffic at the same time. After the filling by this process had been carried for 40 or 50 feet it was necessary to carry the box back again in order that the same space should be filled again in the same slow fashion. In many cases where the grout has been dumped upon the pavements in large quantities the sweeping of same into the joint has required about one hour of labor for each 25 square yards and the cost in small towns where labor is low,



JAEGER MIXER *used to distribute cement filler direct to pavement.*

has varied from $1.00 to $1.25 per square yard.

The first application of cement filler should be thin in order that it may flow to the depth of the brick, thereby insuring a perfect bond. In cases where the filler is too thick it bridges the joints and altho the surface might be smooth a few days traffic will invariably break the slight bond and the bricks immediately roughen and round on the edges, consequently proper mixing of cement filler

plays no small part in the feature qualities of the pavement. The roughing trough has frequently been tried for the mixing and discharging but invariably the cement flows out first, then follows the sand to fill the upper parts of the joints.

The Jaeger Machine Co., Columbus, Ohio, have quite recently perfected a mixer with delivery spout for mixing and distributing cement grout or slushed concrete and it is my belief that this machine fully meets the requirements of engineers and contractors who have been wrestling with the expensive four-legged bin and rocking trough. This machine not only mixes the filler in quantities desired but deposits the grout upon the pavement where wanted, with the sand in proper combination with the solution. This machine is quite light in weight and is easily pulled along the pavement by one man. In other words, it readily sets the pace for the gangs equipped with the push brooms or squeegees.

This machine is of exceedingly simple construction, durable and inexpensive. It is equipped with a 2½ h.p. Vandouzen engine and has two discharge levers and three mixing plows in drum. The largest diameter of the drum is 34 inches. It can be operated at a cost of 3 to 5c per hour for gasoline and is built of iron and steel thruout. This machine is of a size which adjusts itself to both small and large paving operations. It can be operated in direct ratio to the number of broom men employed. The drum holds 1/6 of a yard or 4½ cubic feet at a batch. The drum has all rounding surfaces and there are no corners for the cement filler to lodge in and stick. It revolves on a bear thrust roller and angular spindle.

CLARK METER BOX, *showing method of setting covers in walks.*

Importance of Meter Protection.

By Clarence E. Titus, Manager Northfield Land and Water Co., Colorado Springs, Colo.

Because a water works plant is small is no adequate reason for laxity in its system of records and accounting. Indeed, all the greater should be the necessity for accurate, convenient, systematic and comprehensive records, so as best to eliminate all unnecessary up-keep expense. Good bookkeeping and well-kept records are absolute necessities to the successful conduct of any enterprise, no matter how small or large it may be, or whether it be municipally or privately owned. Even in the smallest water works plant such a system should be employed as will disclose at any time the actual costs of meter breakage, etc., and the reasons for the same. Moreover, it should be in such form that comparisons may readily be made with any corresponding period in the history of the enterprise. To the alert and wide-awake manager such comparisons are fraught with many enlightening suggestions which he will find to be valuable aids in the prosecution of his work. For instance, in the purchase of meters, a comparison of the results obtained from the different makes will disclose which is best and most economical to use. A comparison from day to day of pumpage records, laboratory test records, coal consumption records, recording pressure gage records and watchmen's clock dial records will all be found to be abundantly worth while. Likewise, a comparison from season to season of receipts and disbursements, when properly classified, will tend to emphasize conditions needing correction, and by so pointing out the way to the right sort of management as the business develops and grows will make failure improbable and some degree of success, at least, not too difficult to be realized.

The office records should show completely of what the physical plant consists. Every water main should be definitely shown as to location, connection and size. Every valve, fire hydrant, curb stopbox, meter box and service pipe should be correctly mapped, and each service record made to fully indicate every meter and purpose for which it is to be used by the consumer. These really important matters too many of our

smaller cities entirely disregard. It is my belief that if records were kept as to meter breakage, including cost and cause of breakage, whether it be due to freezing or any other influence, they would have no uncertain tendency toward eliminating considerable expense.

In order that the meter may properly perform its twofold function at the smallest necessary cost, it is absolutely essential that the meter rates be established on a proper basis and that the meter itself be so housed as to be safe from freezing and damage, and that it be so located as to be read with greatest ease and at the smallest expense. In view of the ever-increasing use of meters, no more vital problem today confronts the manager of a water department than the determination of what the meter rates should be in his city; and it is a problem, the solution of which demands the highest degree of skill, careful study of all the conditions and a wide experience in the financial management of water works.

Our experience in meter housing has been exceptionally successful, and we have experienced no freezing or breakage on account of interference since the installation of our present system. We favor outside installations and have sixty housings, with concrete bodies, in sidewalks, the average cost of the concrete box being $1.60 and the cover $2.50, the covers being furnished us by H. W. Clark & Co., Mattoon, Ill., as well as the form for making the concrete bodies. The forms are made of iron and are collapsible.

An ideal meter box is one which is nonabsorbent, durable and low in first cost and maintenance. Concrete measures up well to all these requirements and approaches closely the ideal meter box body. Nevertheless, the success of the concrete body depends not only upon knowledge of methods, care and skill in manipulation, but, like any other construction, upon the selection of proper and durable materials. Enough water should be used so that it will just flush to the top under light tamping in the forms. Probably all who have had anything to do with mixing concrete by hand have noticed that the mass becomes more moist as the mixing progresses. This is because the particles are being forced into closer contact, and indicates that the object of the mixing is being accomplished. The same plasticity is apparently obtained by the use of an excess of water and less mixing. This does not give the same results and should never be substituted for thoro mixing. The mixing should always be conducted in a manner which will not permit of the loss of cement thru the running off of surplus water. Our success with the concrete body justifies us in recommending it to water works superintendents, not only on account of its low cost but everlasting durability.

These meter boxes, which are used for the housing of our ⅝, ¾ and 1-inch meters, are 20 inches in diameter and are placed at a depth of 3½ feet below the surface, 15 inches intervening from the top of the meter to the top of the box. We consider that this location of the meter permits of convenient placing, removing and reading. The usual time consumed in unlocking, reading meter and again locking meter box runs from a minute to 1½ minutes. We prefer the earth to go above the box with a space of about 1½ inches. The partial burying of the cover with paving material combined with the dead air space within the box and radiating surface of the warm earth at the bottom of the box insure absolute protection from frost.

The deepest frost we ever had in this section was in the winter of 1911, when the ground froze to a depth of 4½ feet. The temperature outside of our meter boxes has frequently been 15 degrees below zero, and yet the temperature on the inside of the box was of sufficient warmth to melt the snow on the cover. We consider outside installation of meters as being advisable at all times, as our inspectors are always able to read meters in the shortest possible time; and then there is no chance of any possible connections being made outside of the meter.

Heavy Truck Tires

The accompanying cut shows the Goodyear demountable cushion tire which is proving exceptionally popular for fire department use. This tire is made with a regular demountable truck base, with an extra high dual tread, which is notched and slotted to prevent skidding. It is made of a very resilient, but tough, compound and on account of its resiliency, on the heavier apparatus, is the nearest substitute for pneumatic tires that has been found up to the present time. The tire itself is built for use on high speed fire apparatus and on account of its peculiar construction is so far superior to the ordinary truck tire that it has taken a strong hold in the different municipalities wherever it has been shown.

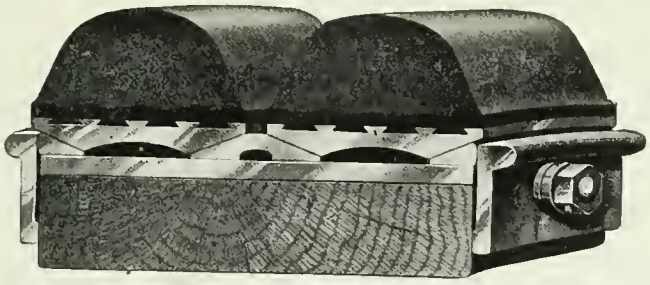
Numerous tests for efficiency and resiliency on this type of tire have been made. One of these tests was made by the city of Dubuque, Iowa, last winter, in which a Robinson fire truck, fully equipped with fourteen men, climbed one of the steepest hills in the city. The street at the time of this test was covered with 8 inches of snow, which had frozen. Just prior to this test an Ahrens machine, equipped with Goodyear demountable

cushion tires, was demonstrated at Racine. The machine had to stand in the mud for two hours, was started and came right out of this muddy spot without chains and started up a short hill of 10 per cent. grade. The visiting fire chiefs at Racine at this time all remarked that they had never seen a tire of this description perform in a like manner. It has always been customary to use chains and a non-skid device to bring a car out of a muddy hole similar to what was encountered at the time of this demonstration. In the city of Rockford this tire has been thoroughly tested and on the eight pieces of apparatus in service at the present time six complete sets of Goodyear demountable cushion tires are in service. Chief Thomas of the Rockford fire department states it is the only thing that he has found that would take the place of a pneumatic tire on heavy apparatus and prevent crystallization of axles and jarring of his engines.

to keep same at all times tight and in proper shape. The new solid rubber tires as furnished by the Goodyear Tire and Rubber Company possess a degree of resiliency approaching the pneumatic.

"Pneumatic tires assure resiliency to the rider in the pleasure car, but they are not suited as runners for heavy motor-driven pumping engine or hook and ladder truck. Resiliency, however, is necessary in the fire truck tire in order to do away with unnecessary racking of the apparatus. Solid rubber tires, provided they have the required non-skid properties, as well as the resilient features of the pneumatic, are best suited for the needs of the fire department. Solid rubber tires are now being made for fire department use, and these tires are almost as resilient as a properly inflated pneumatic. Resiliency is the quality that absorbs the shock on the road, thus protecting the engine and mechanism as well.

"The tender feelings of fire apparatus



DUAL TREAD *demountable cushion tire for fire apparatus.*

"Resiliency in fire truck tires is as requisite as in tires for pleasure cars, but for a different reason," states F. J. Connery, chief of fire department, New Castle, Pa. "The question of power in a piece of motor-driven apparatus is of course governed by the weight of the machine and the kind of ground over which it is to be used. The power should be in excess of that actually required, so that more power can be developed for emergencies than is necessary in the ordinary course of usage. Excess power saves strain, and this excess power is also of value in using the pump, avoiding strain there and giving better service when throwing water for a long period of time. It is impossible to use pneumatic tires on heavy fire apparatus, particularly on heavy pumping engines or triple combinations. Ordinary solid tires do not possess sufficient resiliency and have caused great damage to expensive apparatus as they did not sufficiently reduce the vibration, which tends to loosen in time all parts of the machine. Heavy fire apparatus equipped with solid rubber tires requires constant care and attention

cannot be considered in making the run. Everything must give way to the order, 'Get to the fire in the shortest possible time, property which is being destroyed is far more valuable than the apparatus on which you are riding.' The tire, of course, must withstand all the force and impact of the heavy apparatus in the starting, driving over rough pavements, crossings, obstructions and again in sudden stopping. The fire truck tires must carry enormous weight as well as resist great wear and withstand the heat generated by friction or road surfaces as well as the resistance of the brakes. Furthermore, they must be so constructed as to permit quick removal and ready substitution. The ideal fire truck tire must embody all of these qualities and above all they must not puncture. In my opinion the tire has now been devised which combines all of the above mentioned qualities together with greater lasting qualities, together with added endurance and reliability. These tires are now being used by several large makers of motor-driven fire apparatus."

The Motor Police Patrol.

By Edward C. Haller, Superintendent of Police, Michigan City, Ind.

If the motor-driven police patrol possessed no other advantage than that of rapidity of movement, it would be far superior to horse-drawn apparatus, and for that reason alone should be exclusively used by police departments.

The motor patrol removes the cause of disorder in the quickest possible time and is back at the station in readiness for another call before horse-drawn apparatus can reach the scene of disorder. The saving of time is as essential to the effectiveness of a police department as to the fire department.

degree of efficiency obtained, and a high degree of efficiency cannot be obtained from a cheaply constructed machine. The fact that our truck is built to do much more than the work required of it has eliminated many bothersome breakdowns which have troubled those departments that have purchased their apparatus from the standpoint of price only. Without efficiency there can be no economy. Our 38-h.p., 4-cylinder patrol is equipped with a Kelly motor of the long stroke type, which is very accessible and capable of easy adjustment. This motor is underrated, as is also the carrying capacity of the truck itself. The truck is not sufficiently heavy to bring undue weight on the tires and thereby pile up our ex-

KELLY PATROL *used by police of Michigan City, Ind.*

The motor-driven patrol also eliminates the enormous maintenance expense of horse-drawn patrols. We have no horse-drawn apparatus in our department, our first purchase being a motor-driven machine. The economies effected by the motor as compared with the horse in the other cities influenced us in our decision to start on a motor-driven basis.

Our motor-driven patrol, purchased June, 1912, from the Kelly-Springfield Motor Truck Co., Springfield, Ohio, averaging two calls per day, is still running on its original set of tires. As we have experienced practically no engine or mechanical trouble, our maintenance cost has been exceedingly small. Our runs will average 1½ miles over all kinds of roads, many having steep grades.

Success in the operation of motor-driven patrol depends, of course, on the

pense, but it is very durably constructed thruout and withstood rough handling We have been able to use our patrol entirely independent of road and weather conditions. There are no leakages to deplete the supply of the cooling medium, and there is nothing to freeze.

Our auto patrol thru the great radius of its activity has accomplished more than a mere saving in money, and it has enabled the department to work to much better advantage in every way. Burglars and thieves do not ply their trade so industriously in communities where they know that calls for police will be answered in seconds, where it formerly took minutes.

The statement that a motor-driven patrol must be kept moving to show its superior efficiency over the horse-drawn patrol is not well taken, and is particu-

larly misleading because it inspires the false inference that the contrary is true of the horse. It is my opinion that the value of animal power is more dependent upon motion than is mechanical power. It costs less to keep a motor patrol when it is idle than it does to maintain a horse in his stable. Of course, neither are making any return on the investment at the time they are idle, but the idle truck is much less expensive than the idle horse. The horse requires food to keep him alive, whereas the motor does not eat when it is not working.

The expense of maintaining two horses for a period of six months is so much greater than the expense of maintaining a motor patrol for the same period that no once should ever venture the assertion that a truck's efficiency depends upon keeping it moving. The motor-driven patrol is less expensive and is from five to eight times more efficient than the horse when in action. The most obvious advantage of the motor patrol over the horse-drawn patrol rests in its speed, conducing to promptness of response and to greater radius of action and the ability to continue indefinitely without tiring.

The question of motor patrol reliability under varying conditions has been much discussed by police officials, but it is the unanimous opinion of those police superintendents who have had experience with both types of apparatus that the automobile patrol, if properly cared for, is freer from breakdowns and delays than is the horse-drawn patrol.

The average cost of operating the old style horse-drawn patrol for a period of twelve months in the average city has been estimated as being $611.36, the feed costing $260; horseshoeing, $114.25, and $125 expended for repairs to wagon, sickness of horses, care, etc. Two teams and wagons are invariably required to perform the service rendered by one motor-driven patrol, which would make the cost double that just stated, or $1,222.72. From this amount $72.05 should be deducted for average ambulance hire, leaving $1,150.67 as the cost of the service rendered in a much superior way by the motor patrol for about $600.

Steel vs. Wooden Sidewalk Forms

By Charles Allison, Spring Valley, Ill.

Before the advent of steel forms, concrete for sidewalks, curb, and curb and gutter was molded by means of wooden forms. The contact of wet concrete, however, tends to warp the wood out of shape, besides the nailing and staking necessary in setting them up makes moving difficult without danger of breaking or splitting, which shortened the life of the forms. The skilled labor necessary, time required in setting, and cost of lumber for this work, make these items enter largely into the cost of the job. Metal forms of various types have been designed to overcome this difficulty by securing greater durability of forms, more uniform work, besides saving labor, cost and time required to complete the work.

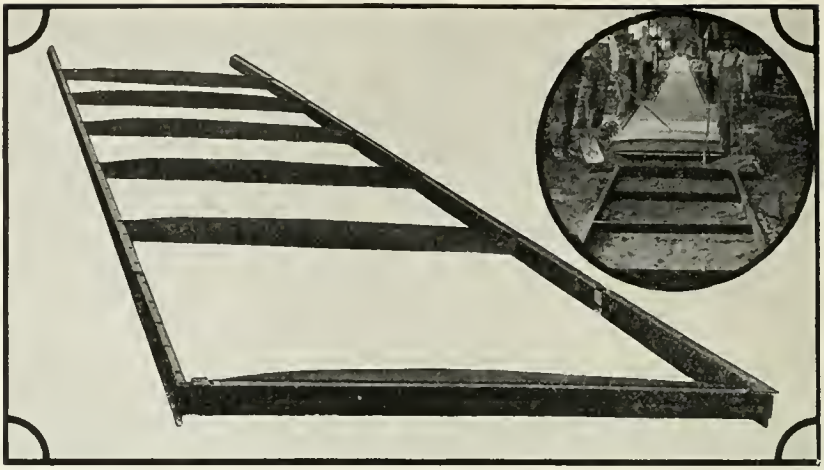
No type of concrete construction is better adapted for the use of steel forms than concrete sidewalk, curb and combined curb and gutter. Although steel forms are more expensive than wood in first cost, their advantages are so many that they are now being used to a large extent in the work of this sort.

Sidewalk side rails are used in constructing crosswalks by having 6 or 8 division plates shaped to suit the cross sectional crown of the walk. By the use of two adjustable rigid side-rails, these forms can be set to build a crosswalk for any width of street. The all-steel curb forms are built for a curb 20 inches deep, 6 inches wide on top and 8 inches on the base, in 12-foot sections, with provision for templates at intervals of 6 feet. The side rails are similar to those used for sidewalks. Templates can be made to conform to any desired specifications.

The all-steel curb and gutter forms are made similar to the combination sidewalk and curb forms, with 3-inch flanges. One wide side rail is used to form the back and a narrow one on the front. With these forms a steel side rail is used to mold the face of the curb and is held in position by a metal arm or brace attachment. These forms are also made for curved sections. Division plates are made to be used with plank side rails for curb and combination curb and gutter.

We use Heltzel forms, furnished us by the W. B. Jones Boiler Company, of Streator, Illinois. The division plates used in these forms are entirely different from those found in other systems as they can be removed by one man without disturbing the side rails and without the use of a hammer. They are connected by merely dropping them in their proper places and no wedges, keys, bolts or moving pivots are required. These division plates are to be had in all lengths up to and including 6 feet and in the construction of a 12-foot walk it is only necessary to double the 6-foot plates and in building a 10-foot walk it is only necessary to double the 5-foot plates.

These division plates do not project or extend above the top or beyond the outside of the side rails. They are perfectly smooth between the side rails and have tapering slots which will not bind when the plate is drawn from the concrete. One of the particular advantages of this system of forms is that there are no inter-



STEEL *sidewalk forms, one hundred feet of which will construct 350 feet of walk per day.*

mediate slots in the division plates to corrode and tear up the concrete when the plates are withdrawn.

The side rails, which are connected together without the use of keys, wedges or bolts, are 12 feet in length and are made of a special shape, comprising three right-angle bends, thus making the construction most rigid and durable. These rails are so made that the top surface is free of any obstruction which would interfere with the free passage of rodding-off tools. They are easily adjustable, thus enabling the workmen to place the forms in any odd space without using wood to fill in. These side rails are so made that it is a simple matter to make a block of any desired size.

It is a very simple matter to so adjust 100 feet of these sidewalk forms that you have 100 feet of curb and gutter forms; all that is necessary is an additional use of 16 curb and gutter templates.

It is a very easy matter to construct 350 feet of sidewalk per day with the use of but 100 feet of these forms. They are simple to place and there is no toggle arrangement to oil and the division plates can be removed before or after finish is applied.

Road Building Funds

By Edward N. Hines, Chairman Board of Wayne County Road Commissioners, Detroit, Mich.

There are three sources of funds with which Wayne county roads may be built and maintained. From whatever source, these funds are placed by the county treasurer in a separate fund, and are disbursed upon warrants issued by the board of county road commissioners, countersigned by the board of county auditors. The first source is the county road tax, which is levied by the board of supervisors at their annual meeting in October, upon recommendation of the board of county road commissioners, which in Wayne county cannot exceed 50 cents on each $10,000 of the equalized assessed valuation of the county for the preceding year. It is payable in December, when all state and county taxes fall due. The tax levied in October, 1911, amounted to a little over 6 cents on $1,000.

The second source of revenue is from the sale of county road bonds, of which $2,000,000 was authorized by the voters of Wayne county at the November, 1910, election, to become available as follows: $200,000 in 1911; $500,000 in 1912; $500,000 in 1913; $500,000 in 1914, and $300,000 in 1915. The principal and interest on these bonds are payable by a small yearly tax levied on the entire valuation of Wayne county. The last of these bonds are to mature in 20 years from date of issue of first installment. The third source of revenue is the state, and is based upon the acceptance of a road built according to a standard set by the state highway department. This state reward is paid irrespective of original cost, and amounts to $1,000 per mile on concrete and macadam roads; $750 a mile on gravelstone roads, and $500 per mile on gravel roads. Wayne county is building roads of a much higher standard than that set by the state. Heavy traffic conditions and freedom from excessive maintenance charges fully warrant the higher standard of construction, and mean an ultimate lower cost than that attained by many other counties in Michigan.

In the construction of our concrete roads the first work is, of course, to properly grade and prepare the sub-grade.

This is done with Port Huron steam hauling engines, spreading dump cars and road rollers.

When grades are unusually steep and hauls very short, road scrapers are used.

PORT HURON *roller hauling scarifier.*

We sometimes find it necessary to use rooter plows. For breaking up old road beds, for reconstruction, Port Huron scarifiers are employed.

Chimney Withstood Severe Wind Strain

By Roy F. Wilcox of J. F. Wilcox & Sons, Council Bluffs, Iowa.

Our attention has been called to your mention of the fact that our concrete chimney withstood the recent cyclone which swept this section, March 23, 1913. It may be of interest to you to know that this storm swept everything in its path, that it did great damage to our plant, which, in fact, was right in the center of the storm. Our buildings were practically destroyed. One of the large brick buildings, near our chimney, was crumpled into a pile, but the chimney is as straight and in as perfect condition as when first erected. It stood the storm better than any structure on the place and as far as we can determine was not damaged in the least. This chimney was erected for us by the Weber Chimney Company, Chicago, and is coniform in type. It is 147 feet 9 inches in height, with an inside diameter at the top of 6 feet.

"The shaft of the Wilcox chimney," writes Mr. Richard A. Steen, president The Weber Chimney Company, "tapers so that at the base of the shaft it has an inside diameter of 9 feet. The shell of the chimney also tapers, being 4 inches thick at the top, increasing in thickness in a uniform ratio so that at the base it is 10 inches in thickness. A concrete lining 4 inches thick is provided, which lining is 45 feet in height from the top of the foundation.

"There is a circular air space between this concrete lining and the outer shell of the chimney 4 inches in width. The foundation of the chimney is 18 feet square, the sides of the foundation rising vertically to a height of 2 feet and from that point being sloped into the shaft of the chimney, the height of the sloping part being 1 foot 9 inches. The reinforcement of this foundation consists of four layers of ½-inch square twisted bars, the two lower layers running diagonally to the sides of the foundation and forming lower network, which is 4 inches and 8 inches, respectively, from the bottom of the foundation. Above this there are two layers placed about 4 inches above the diagonal layers, which run parallel to the sides of the foundation and form the upper network.

"The reinforcement of the shaft of the chimney consists of ½-inch square twisted bars for vertical reinforcement, which bars run down into the foundation and are hooked into the horizontal network heretofore mentioned. The horizontal rings

A CYCLONE *caused this ruin at J. T. Wilcox & Sons' Plant, Council Bluffs, Iowa. Weber concrete chimney in rear remained uninjured.*

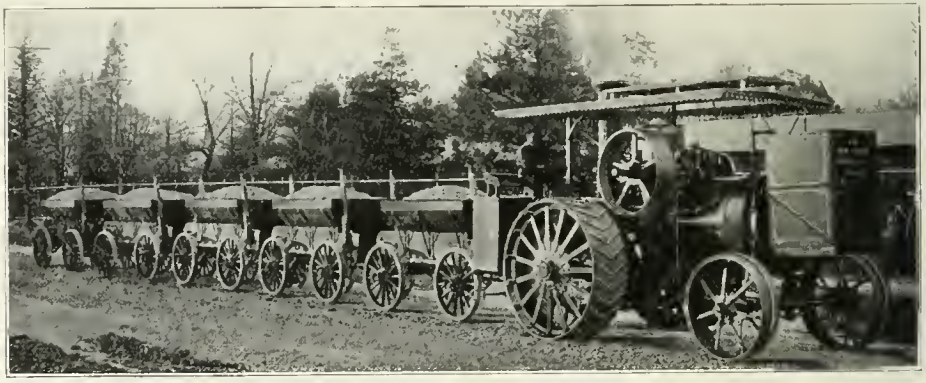
are also placed in the shaft at 14-inch centers. In the lining of the chimney there is a vertical reinforcement of ½-inch square twisted bars and horizontal rings are also placed 14-inch centers in the lining, in each case the rings being ½-inch round bars.

"A smoke opening 4 feet wide and 12 feet high is provided and the outer shell is thickened at the opening and additional reinforcement is placed around the opening.

"The concrete in the foundation is composed of a wet mixture of 1 part of cement, 3 parts of sand and 5 parts of gravel running from 2 inches down. The reinforcement in the shaft and inner shell is composed of a wet mixture of concrete of 1 part of cement, 2½ parts of sand and 4 parts of gravel running from 1 inch down.

"The maximum bearing due to weight and wind on this chimney is 4,080 lbs. per square foot. The soil not being of very good bearing quality, it was decided to drive piles, and thirty-six piles, having a bearing value of 18 tons each, were driven and capped with 6 inches of concrete before the foundation was poured."

It is estimated that a velocity of 125 miles an hour was reached by the wind during the cyclone and the chimney was the only part of the plant not destroyed or injured.



GAS TRACTOR *hauling gravel for road construction.*

Grading and Graveling Streets

By C. C. King, Bro. & Son, Indianapolis, Indiana.

The amount of road improved by gravel more than equals the amount of road constructed by the use of other materials. Probably next to earth road it is the most important because of the quantity of road surfaced with it and its low cost and easy method of construction. The same care should be given to the location and drainage as is given to the earth road. In the construction of the gravel road, beginning with the sub-grade, it is probably best to open the trench to receive the gravel, giving it the same crown or cross section as the finished roadbed should have, which should be a parabola, with the center height equal to 1-40 of the width of the road.

Naturally, the first and most important requisite of a good road is that it shall carry the traffic of all kinds that goes over it, comfortably, economically both for that traffic and for that road. The road must be so designed, built and maintained that it shall be at all times in proper condition to bear the traffic to which it may be subjected, and not only at the least cost to the user, but also at the least ultimate cost to the taxpayers, taking everything into account, viz., interest, sinking fund, yearly maintenance and occasional resurfacing.

Road builders must consider not only the traffic that is now using any given road to be built or resurfaced or even maintained, but also what the traffic will be in the near future, and how much it will increase and what changes will come in its character and volume. After these premises have been ascertained the road-builder can, if he know enough, build or resurface or maintain the road so that it will economically and satisfactorily carry its traffic in a series of years. Without that knowledge he is really entirely at sea; he is likely to make serious and costly errors by determining upon the wrong kind of construction and by selecting improper or unsuitable materials or methods.

Road building machinery should only be purchased after a thoro investigation, especially in regard to the liability of breakdown and the expense of upkeep. The expense of repairs on road-building machinery is very small in comparison

with the loss which is occasioned by disorganizing of working crews due to breakdowns. In deciding upon the purchase of machinery too much weight should not be given to the item of first cost, as the more expensive machine in first cost may be a far cheaper machine to operate and may be depended upon to do its work day in and day out where a cheaper machine, although it may not break down, is very liable to do so.

Where there is enough work to keep a hauling engine busy and suitable provision can be made for loading and unloading quickly, a hauling engine may be used to advantage, and is about 50 per cent. cheaper than hauling with horses. There is still an opportunity for improvement in many hauling engines, especially in regard to gearing and traction wheels, most of the makers using cast-steel gears, which are uncut and very rough, and which wear very quickly. They also use a built-up riveted or bolted wheel with rolled steel rim. These wheels are generally a source of trouble, as the spokes get loose and break where the traveling is rough and stony, as it is on most construction work.

There is no class of road-building machinery which has been so highly developed as the traction engine. The wide variation in first cost of the different makes of gas tractors makes it very difficult for a contractor to make up his mind which one ought to be purchased. There is almost as much difference in tractors as there is in watches. You may purchase a watch for a dollar which is liable to keep good time for a year and it is liable not to do so. You may purchase a watch which costs almost any price, and in every case you will probably get just what you pay for. As a general thing the higher the price, up to a certain limit, the more dependable the watch is, and the same rule applies to tractors. There is no road-building machinery sold that I know of upon which an exorbitant profit is being made. In looking over a tractor with the view of purchasing particular attention should be given to an investigation of the gearing and wheels. You can tell by the looks of the wheels and gears upon the machine which has been in use whether or not that machine is going to do your work day in and day out as it ought to.

We are using three Huber gas tractors on our present work of grading and gravelling streets for our addition to the city of Indianapolis. This subdivision covers 360 acres and the tractors are proving very effective machines in this work. They are economical in many ways. They travel at a higher average of speed with heavy loads than is possible with horses. The greatest economy can be effected, however, by increasing the load as well as the speed and this can easily be done when these tractors are operated. During the exceedingly warm days of June these tractors work just as vigorously as we desire; they do not become tired, neither was it necessary to spend time and money in grooming and feeding them. As soon as a tractor stops working the expense ceases.

Two workmen can easily handle the tractor and a long wagon train, thus saving the wages of at least ten men. It is safe to state that the fuel consumed by the tractor could be more than paid for by the amount saved on horse feed alone.

The width of these tractors is not so great but that they can be used on all ordinary roads. The drive wheels are very high and the wide tires grip the ground in a most secure fashion. On account of the weight distribution as well as the draw-bar-pull adjustment enormous pulling power can be obtained on a minimum quantity of gasoline or oil.

Utility Street Paving Mixer

"The laying of concrete in street paving presents its peculiar difficulties owing to the wide distribution of the product, the limited area available for operation and the frequent necessity of keeping part of the highway open for traffic," writes G. L. Sexton, General Manager of the Cedar Rapids Mixer & Machinery Co., Cedar Rapids, Iowa, "and it was with these ideas in mind that we have designed a new concrete mixer known as 'the Utility.'"

"This new mixer is charged from the rear by means of an elevating skip which has a capacity of over 40 cubic feet of dry materials and which is raised and lowered by means of sheaves and cables, the lower car wheels rearing on the channel tracks which form the incline to the point of an automatic knock-out.

This machine differs widely from other street paving machines as the batch hopper bin is located just to the front of the drum and has a capacity equal to that of the loading skip, hence it is unnecessary to hold the loader in the air waiting for a batch to be completed in the drum, as the bin has a vertical cut-off in the throat which can be operated at will, the materials therein falling into the mixing drum at a pitch of 45 degrees. The extreme height of the machine is 13 feet 4 inches, feed level 2 inches, extreme width 9 feet 7 inches, extreme length without distributers 25 feet 10 inches, with distributers, 40 feet 10 inches, height of discharge spout without distributers or bin 4 feet 3 inches, height of discharge without distributing trough 13 inches. Weight without distributers is

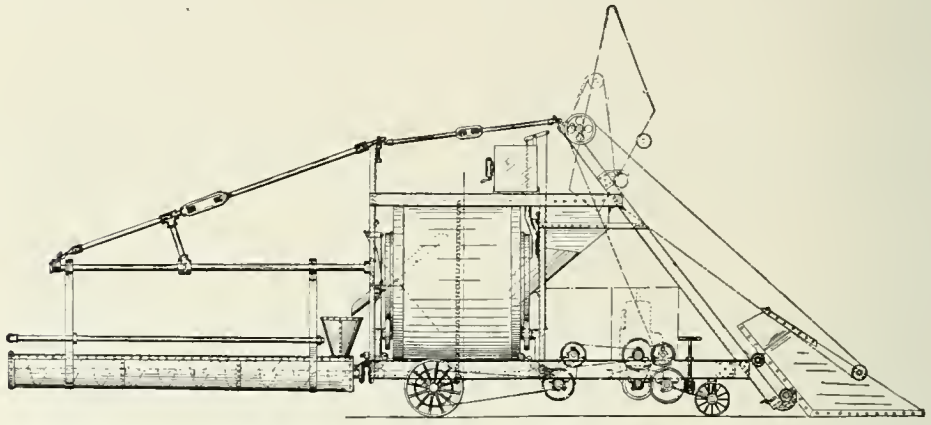
approximately 11,000 pounds, with distributing trough, 13,500 pounds.

The drum, which consists of two 9-foot steel heads pressed out of 5/16-inch material and securely riveted to a wearing surface of the same metal and thickness, is 7 feet in diameter and 5 feet 6 inches in length, having a capacity of more than a cubic yard of mixed concrete per batch. The drum openings are each 24 inches in diameter.

The mixing is accomplished by means of seven sets of blades and buckets, together with the internal discharge spout acting as a deflector for the materials falling thereon, which are folded back and forward across the drum until the spout is placed in the proper position to discharge. All operating levers, including the clutches for operating the traction device, loading and unloading spouts and gates are so banked as to require but one man in their operation.

steel, the front axle being of open hearth channel steel and so arranged as to carry an equally distributed load of 16,000 pounds. The steering device is of the worm gear type and is operated by means of a 14-inch hand wheel. The loading skip, which is wide enough for two wheelers to enter with barrows simultaneously, carries a full batch to the upper batch hopper or storage bin and returns to the ground level without waiting.

The rear driving wheels are 30 inches in diameter and have a 12-inch face, fitted with cleats and extra bands for city traction. The front wheels are 18 inches in diameter and have a face of 10 inches with 5/8-inch tires. The structural steel used in this machine is all drilled and rivets are driven hot. The main frame is built up of 10-inch channels reinforced with cross I-beams, gusset plates, etc. The uprights are of 6-inch channels, as is the



PLAN of 40-*cubic-yard paving mixer.*

The water supply is carried in a 100-gallon steel tank at the top of the machine and has a 3-inch discharge pipe leading to the drum, the same being operated by means of a flush valve.

The rollers that travel the machined cast surface riveted to the drum ends and on which the drum revolves are 16 inches in diameter and have a 2½-inch face. These rollers are fitted with Hyatt roller bearing for reducing friction and are equipped with a felt dust guard in each end of the hobs.

This machine is self-propelling and is equipped with special driving sprockets and heavy duty diamond chain, the clutches being so arranged as to throw out either of the rear drivers when rounding a corner. It has a speed forward of a mile and one-half per hour and a reverse motion of one mile per hour. The rear axle is made of 4-inch cold rolled

top frame. The incline over which the loader travels is also constructed of 6-inch channels braced with 3-inch angles.

The power plant, which is located under the inclined tracks of the loader and is completely covered with a metal housing, consists of a very high duty 45 h.p. gasoline engine of the auto type.

This machine is arranged for an end discharge. Special attention is called to the various means of distribution which can be furnished with this outfit to meet the several conditions which contractors are called upon to solve, as follows:

Outfit No. 1 consists of mixer proper equipped with a storage bin at the end of the mixer to hold a batch of mixed concrete.

Outfit No. 2 consists of mixer proper equipped with a steel boom swinging at a radius of 180 degrees. A drop bottom bucket of 1 yard capacity is so arranged

Chestnut Street, Sewickley, Pa. Resurfaced with "Tarvia X."

Sewickley's Experience with Tarvia

The Borough of Sewickley, Pa., has used "Tarvia A" as a surface treatment on its macadam roads for several years. Some of these were last treated in 1909 and all are still in excellent condition.

Chestnut Street has been resurfaced and other heavily-traveled thoroughfares have been constructed with "Tarvia X" as a binder. The local authorities report that they are "well pleased with the results."

In December, 1912, M. M. Baker, Borough Engineer, wrote:—

> During the past few years the Borough of Sewickley has used "Tarvia X" and "Tarvia A" in the construction of new driveways on some of the most heavily traveled streets, and for resurfacing of a number of streets situated in the residence section.
>
> Both of these paving materials have stood the test well and we are glad to have the opportunity of expressing our satisfaction with the way in which they have "made good," and to recommend them for use in other municipalities where a first-class paving material is desired.

"Tarvia X" is a dense, viscid coal tar product which thoroughly binds and waterproofs the crushed-stone wearing course of modern roadways and pavements. "Tarvia A" is of lighter consistency for use in resurfacing water-bound macadam roadways. "Tarvia B" is a dust layer and road preserver used cold on macadam roads already in use.

Booklets on Request.

BARRETT MANUFACTURING COMPANY

TRADE B MARK

New York Chicago Philadelphia Boston St. Louis Kansas City Cleveland Cincinnati Minneapolis Pittsburgh Seattle Birmingham

The Paterson Mfg. Co., Ltd.—Montreal, Toronto, Winnipeg, Vancouver, St. John, Halifax, Sydney, N. S.

as to travel any required distance on the boom.

Outfit No. 3 consists of the mixer proper equipped with an open top steel trough into which concrete is spouted thru a funnel-shaped hopper from the discharge spout and is carried to the end of the trough by means of a spiral mixing screw conveyor.

Outfit No. 4 consists of the mixer proper equipped with a special collapsible steel chute having a length ranging from 4 feet to 16 feet.

Cleaning Sewers Clogged by Floods

By J. A. Holzberger, Director of Public Service, Hamilton, Ohio.

In spite of all precautions to the contrary, sewers continue to clog and as knowledge has increased with respect to decomposition of sewage, it has become clearly recognized that additional care should be required in properly cleaning sewers and thereby guarding against objectionable odors. Where the interior surfaces of the sewers are rough and where projecting masonry allows deposits to be built up in front of it, it is quite possible that in these deposits anaerobic conditions are established in a manner and to an extent that is much more conducive to objectionable odors than is generally considered in this country by those who deal in reasonably well-designed and constructed sewers. The formation of enzymes or soluble fermentation compounds may do much more towards bringing about putrefaction than hitherto realized. German investigators believe this to be true where they have studied old combined sewers.

It is many times impossible to thoroly clean clogged sewers by mere flushing, as many municipalities have found that this method washes a large amount of sand, gravel and other debris caused by the sewers silting up. In one or two places it is necessary to clean them many times a year, and in almost all cases at least twice a year.

One of the most important problems any city is called upon to solve is that of keeping its sewers unobstructed, clean and wholesome at the minimum cost. The experience of most cities has been that ordinary methods of sewer cleaning result in a great waste of water and labor and that the expense of same is entirely out of proportion to the results accomplished.

The recent floods compactly clogged the sewers of Hamilton with the debris that only a flood can carry. The force of the flood waters most thoroly compacted this debris, so much so in fact that the obstruction forced back the flood waters, realizing that it was absolutely necessary that our sewers be opened up and thoroly cleaned in the shortest possible time. We investigated several methods of accomplishing the desired results. Flushing would not do, as we could not secure any water pressure of greater velocity and force than the flood waters our sewer obstruction withstood. The sewers of Hamilton were simply packed with gravel, sand, mud and every other imaginable species of debris, which was in fact tamped and rammed into our sewer lines so solidly and compactly that its removal seemed almost impossible.

We investigated the turbine machine as made by the Turbine Sewer Renovating Machine Company of Milwaukee and this machine thoroughly cleaned the badly clogged sewers at a cost of 2¼ cents per foot. This practical demonstration of this machine convinced us as to its ability to cut out and remove all sewer obstruction and we will consequently continue to use this system in the future. The turbine consists of a barrel provided with four runners on which it rides when moving through the sewer. Within the barrel is a water motor, the shaft of which extends out of the front end and carries a series of hook-shaped cutting blades. The rear end of the barrel is provided with a hose connection by means of which the water for operating the motor is delivered. Finally there are rope connections in front and rear.

In operation a hose from the nearest hydrant is attached to the barrel and the cleaner is hauled through the sewer between manholes by windlasses. As the cleaner advances the cutting blades operated by the motor cut and grind away the sediment which is carried away by the stream of waste water from the motor. This hose has, of course, to be long enough to reach from the hydrant down the first manhole and through the sewer to the second manhole. Four men nominally operate the cleaner, two ahead operating the second windlass to pull the cleaner and two at the first manhole to feed in the hose and back rope.

Concrete Pavements at Connersville, Ind., and DeKalb, Ill.

Connersville, Ind., contracted for the construction of 65,000 yards of reinforced concrete pavement during the year 1912 at a cost of $1.02 per square yard, including excavation. The base is 5 inches thick at the curb and 7 inches at the center and the top or wearing course is 1½ inches thick over the entire pavement. The concrete for the base is mixed one part of Portland cement, two parts of sand and four parts of crushed stone or gravel. The mixture for the wearing course is one part of cement to one and

THE HUBER ROAD ROLLER
AND SCARIFIER ATTACHMENT
LOWERS ROAD BUILDING COSTS

"No City or County can afford to be without these combination machines."

The Huber Road Roller

—with its unsurpassed **surplus of traction** power easily hauls graders, scarifiers and long wagon trains, thus eliminating necessity of separate hauling engines.
—Exceptionally strong in the belt, and furnishes most economical power for running of stationary machinery.

—attached to the rear axle which sustains all the pulling strain—ready for use the instant wanted—carried clear of ground and out of the way when not needed—tears up ground uniformly, regardless of the position of ground wheels—depth regulated by guides at either side—piston working against steam in a simple, independent cylinder gives cushion compression on spikes steam power raises spikes from ground as desired—a single lever operates it either way—works close to curb.

The Huber Scarifier

You cannot afford to invest in a roller until you are thoroughly posted on The Huber.

SEND FOR COMPLETE PARTICULARS

The Huber Manufacturing Co.

601 Center St. MARION, OHIO.

one-half parts of clean sharp sand. The pavement is reinforced with triangle mesh style No. 7, placed between the top and base courses. Extension joints protected by means of Baker armor plate and filled with an asphalt filler are placed along the curbs and across the street every 30 feet. The material and labor costs were as follows:

Cement, $1.02 per barrel.
Sand, 50 cents per cu. yd.
Gravel, 45 cents per cu. yd.
All f. o. b. Connersville, Ind.
Common labor, $1 per day.

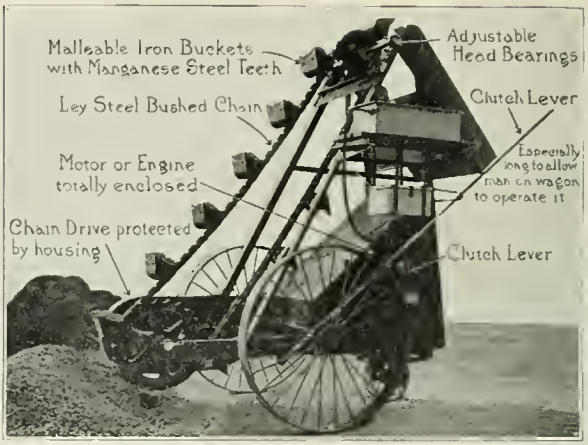
The designing engineer was W. F. Ridpath, city engineer of Connersville, and the contractors were Greenwood, Connor, Boots & Gant, of Connersville, Ind. It may be interesting to note the comparative bids for other types of pavements that were entered at the time the contract was let for this Connersville work. The bids for brick pavements varied from $1.62 to $1.98 per square yard and for asphalt from $1.65 to $1.95 per square yard. Bids were asked for the following four types of concrete pavements:

One-course with Baker armor plate protected joints; the bids entered vary from $0.93 to $1.15 per square yard; two-course work with armor plate joint protection, bids varied from $0.99 to $1.44 per square yard; two-course with armor plate joint protection and wire mesh reinforcement, from $1.02 to $1.51 per square yard; two-course work without armor plate joint protection, but using wire mesh reinforcement, $0.96 to $1.50 per square yard. It will be noted that it was decided to use the highest class of construction using the two-course reinforced concrete type and all joints protected with steel plates.

The township of DeKalb, Ill., constructed a short piece of reinforced concrete roadway pavement in 1912, the work being done under the supervision of A. N. Johnson, state engineer. The pavement consists of one-course work, laid 6½ inches thick, the concrete mixture being 1, 2 and 3. Expansion joints were constructed across the pavement every 50 feet and protected by the Baker steel armor plate.

Wagon Loaders for Handling Sand, Stone and Gravel

In the Stone Age men who had need of a quantity of sand or stone, went to the nearest source of supply, filled a sack or skin by hand, slung it on their shoulders and walked back with it. Later some inventive genius constructed wagons or carts, and the more or less round wheels were probably looked upon as the last word in mechanical invention. After a while a shovel for loading carts was invented, and this combination of carrying in carts and loading by shovels has been in universal use ever since. Railroad cars are carts adapted to long hauls, and automobile trucks have somewhat replaced horse-drawn vehicles, but the loading of these, except in very large operations, is slow and done by hand labor. With the introduction of the steam shovel and the automatic grab bucket, a great advance in speed and economy was made, but the first cost, and difficulty of moving these outfits about, make them economical only where they are used in the same place or moved a moderate distance.


Malleable Iron Buckets with Manganese Steel Teeth
Adjustable Head Bearings
Ley Steel Bushed Chain
Clutch Lever
Especially long to allow man on wagon to operate it
Motor or Engine totally enclosed
Chain Drive protected by housing
Clutch Lever

1. LINK-BELT *portable loading machine for raising materials to wagons and cars.*

This is the second Stone Age. The tremendous increase of the recent years in the use of sand and stone, due to the growth of concrete work, and the great amount of road building, has caused the handling and re-handling of millions of tons of material, and in nine cases out of ten it has been done in the original shovel and cart way. This is especially true in the case of road building, where the location of the work is constantly changing, making necessary the loading and unloading of all the material used in construction. The unloading has been simplified by the dump carts and self-dumping wagon, but the loading has been done by the same conditions which the ancients used—the man with the shovel. This is hard and exhausting work, and with the constant increase in wages and shortening of the length of the standard working day, has become a large and uneconomical item in the cost of any large piece of

The Brown Hotel Des Moines, Iowa. The Brown Apartment Co., Owner

H. L. Stevens & Co., Chicago, Architects The Van Dyck Heating & Plumbing Co., Des Moines, Heating Contractors

KEWANEE

Smokeless Firebox Boilers

Mr. Ernest W. Brown, President of the Brown Apartment Company, owner of the above building, writes us: "I have done a great deal of boosting for your boilers since you installed them in our building. They have certainly been satisfactory and also very economical."

Two No. 112 KEWANEE Smokeless Firebox Boilers Installed Therein

KEWANEE BOILER COMPANY

Kewanee, Illinois

Steel Power and Heating Boilers
Radiators, Tanks & Garbage Burners

Branches: Chicago, St. Louis
New York, Kansas City, Salt Lake City

work. In these days of close margins and competition, nobody can afford to overlook any department of his business which is capable of improvement along the lines of efficiency; and here, in the loading of

2. LINK-BELT *machine equipped for loading sand.*

carts, we have a source of waste, and a very large one, which is increasing each year by leaps and bounds, in direct proportion to the amount of material to be handled.

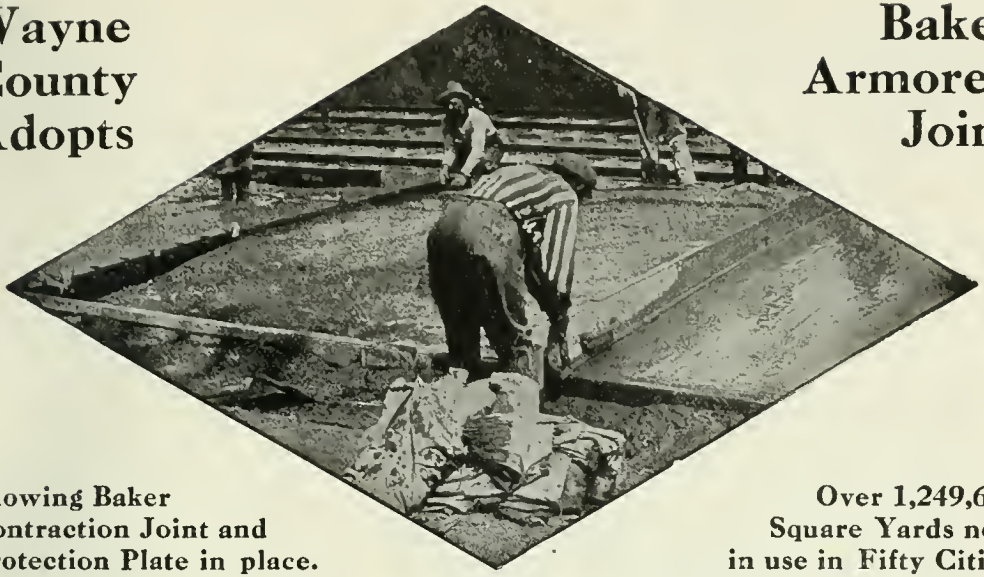
For example: Suppose you have a contract which includes the loading of several thousand tons of sand, stone or gravel from piles on the ground to cars or carts. The pay of laborers, the cost of transportation in carts, the first cost of material, the unloading of the material from the carts, these are all practically fixed amounts. The cost of loading the material from the storage piles into carts, however, is capable of a large reduction. This can be done by the use of an elevator mounted on wheels so as to be regularly moved about, and operated by small motor or gasoline engine. Such a machine is shown in Cut No. 1. It consists essentially of a single strand bucket elevator, with buckets attached at intervals of about 2 feet, the whole mounted on a steel truck with large wheels. The elevator delivers to a chute from which carts are filled. The continuous feature of this elevator makes possible a high capacity, and the short lift uses but little power. For handling gritty materials, a chain is used which has in its joints case-hardened pins and bushings which greatly prolong its life; and for handling material like crushed stone, the buckets are fitted with manganese steel digging teeth or prongs, to prevent the excessive wear caused by the stone. These machines are not 'diggers' in the sense that they can be run back into a pile and made to dig it up, but the material must be trimmed by hand to the foot wheel by one or more men. The machine thus saves the labor of lifting the dead weight from the ground level over the side of the cart, and of course, when handling material such as sized gravel or anything that runs readily, a large amount can be fed to the foot of the machine by cascading or pulling down by shovels. This is especially true in handling hard coal or dry sand where the angle of flow is fairly flat.

In actual operation, the engine of the machine is started, and a clutch thrown in, which puts the chain and buckets in motion, and the machine is backed into the pile until the buckets strike the material. They will pull through the material as long as it flows by gravity, but finally the buckets will have made for themselves a clear path. The material is then trimmed or fed by men with shovels into reach of buckets, and it is so much easier for men to push the material down in this way than to throw by shovelfuls

3. EQUIPPED *with rotary screen and especially adaptable for repaving work.*

Wayne County Adopts

Baker Armored Joint



Showing Baker Contraction Joint and Protection Plate in place.

Over 1,249,678 Square Yards now in use in Fifty Cities.

BECAUSE

It is the only method of protecting the expansion joints in concrete pavements against abrasion and at the same time insures a smooth, even joint absolutely flush with the general surface of the concrete.

"The only surface repair required on our concrete roads has been on the roads first constructed, where the joints were not protected with 'armor plates.'"

[Extract from the Sixth Annual Report of the Board of County Road Commissioners of Wayne County. Mich., Sept. 30th, 1912.]

All Necessary Apparatus

is furnished with each shipment of armor plates, free of charge.

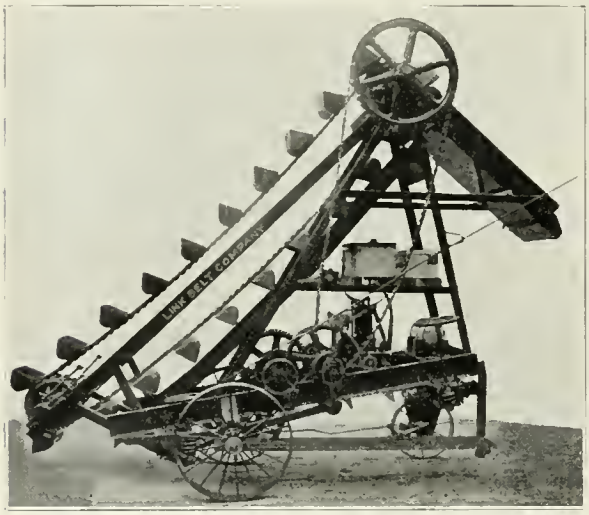
We guarantee Baker Armor Plates to be perfectly crowned as specified, and entirely free from any defects of manufacture.

Upon request we will send you booklet containing illustrations, specifications and full details.

THE R. D. BAKER COMPANY

DETROIT, MICHIGAN.

into the cart, that two men with one of these machines have handled sand at the rate of forty tons an hour, and one man working on hard coal can handle a ton a minute. Here, then, is the source of economy. By the use of a simple machine, such as outlined above, two or three men can put material into carts at a rate which would require at least ten men if using shovels in the old time way. In dollars and cents it has been proved that a saving of from 5c to 10c a ton can be made in handling materials in any large quantity. From this it is easy to see what a large field there is for this type of machinery, and what a large saving can be effected when the quantity is anything over 20 tons a day. Portable loaders are also being used by a number of concerns merely to relieve the congestion in their yards, even tho the loading is done by the cart drivers who are paid by the purchasers of the sand.



4. EQUIPPED *with bevel drive and stearing gear for self-propulsion over short distances.*

Starting with the original idea of an elevator mounted on wheels, a surprising number of modifications have been made in their use. Cut No. 3, page 190, shows one of these. It consists essentially of the addition of a rotary screen at the head of the elevator, delivering screenings to one chute and rejections to another. This type of machine has been used mostly for repaving macadam roads. The old macadam is plowed up and broken, and fed by a gang of men to the foot of the elevator, which delivers it into the screen. By means of the screen the sand and dirt are taken out and delivered to a wagon on the side, and the rejections of the screen, consisting of screened material of a certain size, are delivered to a wagon on the other side and can be used over again for the new work. It is very easy to see what a large saving this effects, to produce a clean sized product, right on the scene of operation, ready to use, and loaded in wagons.

Another modification of these machines is shown in Cut No. 4. On this type, driving gears have been added to make the machine self-propelled in either direction. The operator stands on the running board at the head of the frame, with his starting and stopping levers, steering gear and engine control, all within easy reach. The advantage, of course, of the self-propelled type is in traveling short distances, and in moving from one bin to another where several kinds of material have to he handled. The capacity of all of these types of machines is about 50 tons an hour, but this, of course, can be very easily increased or cut down by changes in the size of the buckets. In actual practice, while the buckets have a theoretical capacity of 50 tons an hour, the amount of material delivered into the wagon by the machine depends entirely on the uniformity with which the material is trimmed or fed to the machine, and this is largely a matter of practice with the trimmers.

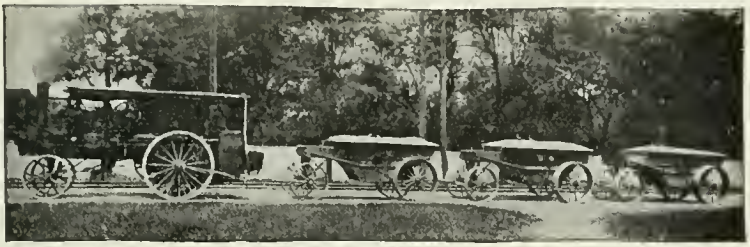
Cut 2, p. 190, shows another form of machine designed for handling sand. The elevator is made slightly steeper, and the spout at the head is pivoted so that it can discharge in front or on either side of the machine. This feature makes for speed. In a case like the one shown in the cut, a car can be run to one side of the machine and be filled, and in the meantime another car placed in position at the far side. The spout is rotated thru 180 degrees, which delivers the supply at once to the second car, eliminating practically all waiting for cars. The elevator shown in the cut was installed in a sand bank 40 to 50 feet in height, and on account of the soft nature of the ground was operated on planking. A large amount of material, however, can be trimmed down the bank without moving the machine. When the angle of repose of the sand is about reached, 2 or 3 feet is cleared away from in front of the wheels, and two or three planks are laid on which to roll the machine back within reach of the bank.

From the fact that most sand or gravel banks and sand piles are remote from

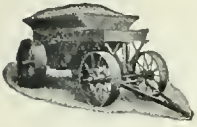
Port Huron ASK THE USER

Take the Port Huron Line If You Want Good Roads

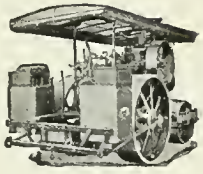
Port Huron ASK THE USER



After the grade is prepared the material is hauled on the road largely by our Port Huron steam road engines. Each Port Huron hauling wagon shown above contains seven tons of material, and on an average length haul will make as many trips per day as a good team. EDWARD N. HINES,
Board of County Road Commissioners, Wayne County, Mich.



The Port Huron Line
means
GOOD ROADS
at
MINIMUM COST



The New York–Port Huron "Standard" Road Rollers—2 sizes.

Port Huron General Purpose Road Rollers—4 sizes.

Port Huron Hauling Engines.

The Port Huron All-Steel Hand-Steering, Reversible, Stone Spreading and Dump Cars.

Port Huron All-Steel Stone Spreading and Dump Cars.

New York–Port Huron Scarifiers.

Port Huron Road Making Machinery.

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PORT HURON ENGINE & THRESHER COMPANY
PORT HURON, MICH.

We are prepared to Furnish any Machine, Implement or Tool used in the construction of good roads.

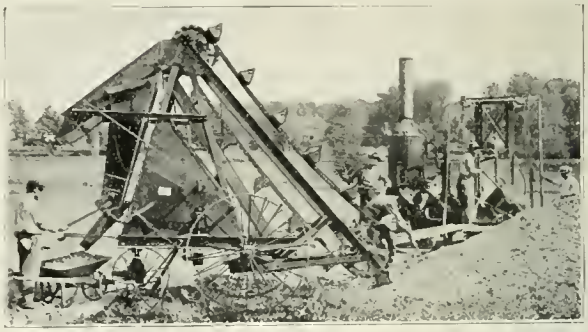
Representatives in all principal cities. ***Booklet No. 10 on request.***

the source of electric current, a majority of these machines are equipped with gasoline engines. The engines are similar to those used on agricultural and farming machinery, and are fitted with a magneto which saves all trouble with batteries, and also a governor to keep the speed within limits. The load on the elevator is of course, constantly varying, and the use of the governor prevents any racing of the engine at periods of light load.

Cut No. 5 shows one of the most successful applications of the portable loader. This machine is being used on a contract calling for several miles of concrete road bed, 20 feet wide and 6 inches thick The stone and sand are deposited by carts in piles as shown, at intervals of about 200 yards. The concrete is mixed in a portable mixer, and the value of a wagon loader here is in the speed with which the wheelbarrows can be loaded for filling the mixer. The loader was fitted with a special chute and gate for filling the barrows, and the chute has a capacity of several barrow loads of stone. The one or two men can keep the hopper full, and when a man wants a barrow load of stone he can get it in less than five seconds. The foreman in charge of this work states that from his previous experience in road building, he estimates that three men and this machine replace a force of ten men, which he has had to have for this operation on all his former work. The upper chute on this loader is of course used for filling wagons, and is put in operation by the closing of the gate leading to the wheelbarrow storage hopper. The location of the stone and sand piles, and the quantities in them, are calculated to keep just ahead of the finished road-bed, and when one pile is used up, the mixer and loader are pulled by horses to the next stone pile.

Another very successful application of the wagon loader is in quarries, where there are no storage pockets. Stone can be stored in fall and winter, and at a very small proportional cost it may be reloaded into carts and wagons for shipment at the height of the season. Most quarries find a ready market for all the stone they can produce in the summer, and it is a well known fact that larger quantities of this material could be sold if the producers stored the stone in large piles. Heretofore, because of the high cost of moving these piles, it was not considered wise to make large storage piles. With the portable wagon loader, however, these large piles are now moved with the minimum of expense and at a good profit.

While a great many portable wagon loaders are in successful daily operation handling stone, sand, gravel, coal, earth, pyrites, etc., their general use for loading materials is only in its infancy. With the increased difficulties of securing efficient common labor, employers are finding it profitable to use modern labor-saving machinery. The wagon loader will not go on strikes, or lay off on special holidays, etc. Teamsters, as a rule, are well pleased with the loading machines, as they are relieved of the work of shoveling into wagons. All the wagon loaders described in this article were manufactured by the Link-Belt Company, of Philadelphia.

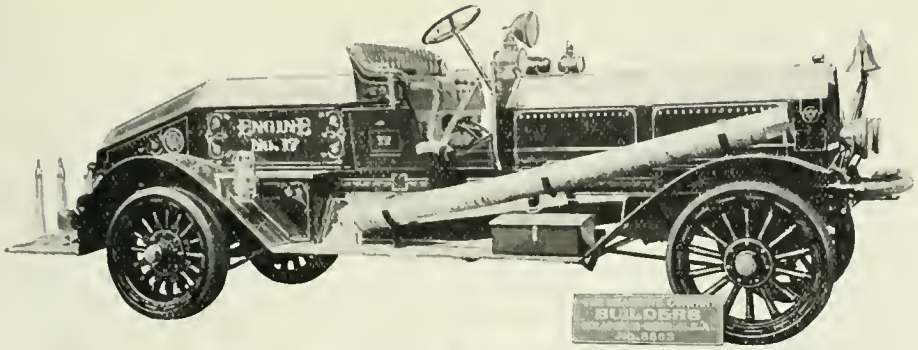


5. LOADER *in use on concrete pavement work equipped with two chutes, the upper for wagon-filling, the lower for wheelbarrows.*

Proper Housing of Meters

By Harry Ruthauff, Commissioner Department of Public Property, City of Decatur, Ill.

In the year 1907 we started a systematic housing of our water meters believing that the installation of a practical and uniform meter box thruout the city would be most beneficial for all concerned. Our experience previous to 1907 proved that meter boxes should not only be considered as housing for meters but that the most efficient meter box is that box which would permit of the most ready access for reading, inspection or repairs at all times. After considerable investigation we, in 1907 purchased from the H. W. Clark Company at Mattoon, Illinois, an iron collapsible form. This form enables us to make concrete boxes at a very small expense which we furnish to the consumer at cost, namely 75 cents. The lids are shipped to us by the H. W. Clark Company which are also furnished the consumer at cost, namely



SEAGRAVE

Multi-Stage-Centrifugal Pumping Engine

1000 Gallons per Minute at 120 lbs. Pump Pressure
600 Gallons per Minute at 200 lbs. Pump Pressure

Built in two sizes, 750 and 1000 gallons capacity per minute at 120 lbs. Pump Pressure and can be furnished with or without hose body and chemical tanks, as desired.

DELIVERS MORE GALLONS PER MINUTE AT HIGHER PRESSURE THAN ANY OTHER PUMPING ENGINE IN THE WORLD.

No Wearing Parts	**No Springs**
No Relief Valves	**No Vibration**
Slow Speed Motor	**High Efficiency**

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THE SEAGRAVE COMPANY

COLUMBUS, OHIO

$2.50, thus making the total cost of meter box, complete to consumer about $3.25.

CLARK *Collapsible Form for constructing concrete meter boxes.*

We installed twelve of these meter boxes in 1907. They were so satisfactory that we made 438 installations in 1908, and since that date we have installed 53 more.

had any trouble whatever on account of freezing. This record has been made in spite of the fact that these installations have been subjected to 23 degrees below zero weather.

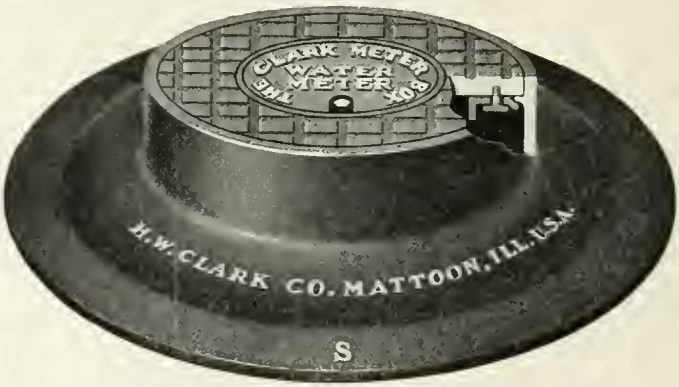
Our experience has taught us that the outside installation of meters, so housed, is not only practical but exceedingly economical. Outside installations can be read without annoyance to consumer or loss of inspector's time in making return trips occasioned thru occupants of premises not being at home.

The heavy cast iron covers of these boxes are partially covered over with paving material or earth. Absolute protection from frost is secured by this partial bearing of the earth. The only portion of the housing which is exposed is the 8-inch lid. The large air space within the box together with the radiating surface of the earth at the bottom of the box, below the frost line, permits the natural warmth of the earth to surround the meter and the riser pipes. These riser pipes being away from the walls of the box permit this warm air to completely surround them and thus there is no frost connection to the meter itself.

Laying Cement Sidewalks

By P. W. Fowler, Contractor, Topeka, Kansas.

At the present time the question of sidewalk building is receiving merited consideration, and the reason for this is



CAST IRON *cover for Clark Concrete Meter Boxes.*

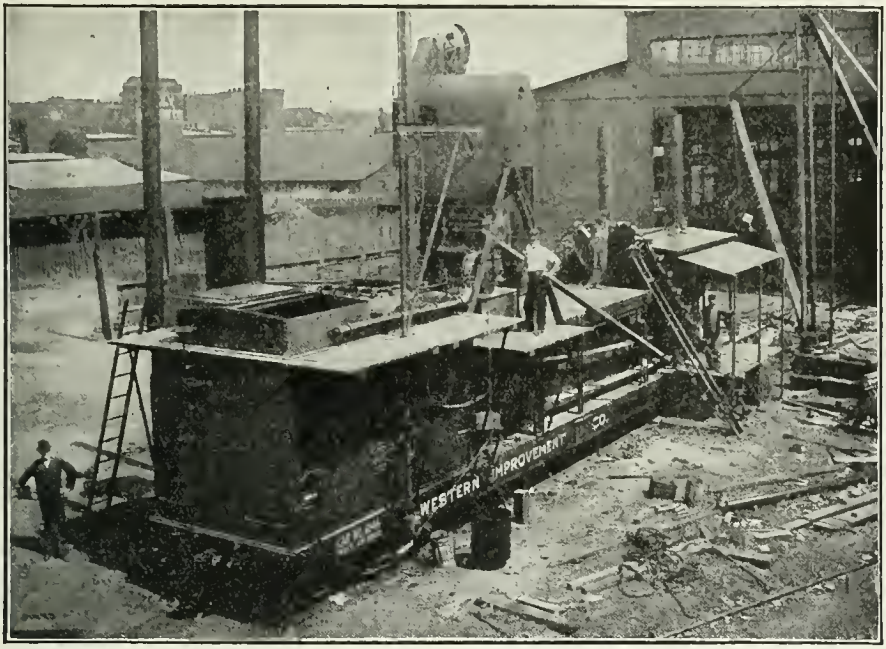
Meters when properly placed in one of these boxes will not freeze. There must not be any dirt left in the box above the bottom of same however.

We set all of our meters 18 inches from top of lid to top of counter on meter and while we have had some extremely cold weather since our meter system has been installed we have not

very apparent. It is just as important that a sidewalk be properly constructed as it is that a pavement receive due attention.

The "cheapness of first cost" has fortunately been exploded. When that alone is its only recommendation, "hit or miss" sidewalk construction is bound to plunge into debt the community adopting it.

MODEL OF 1912 ONE-CAR PLANT.



1,000 SQUARE YARDS 2-INCH TOPPING PER DAY.

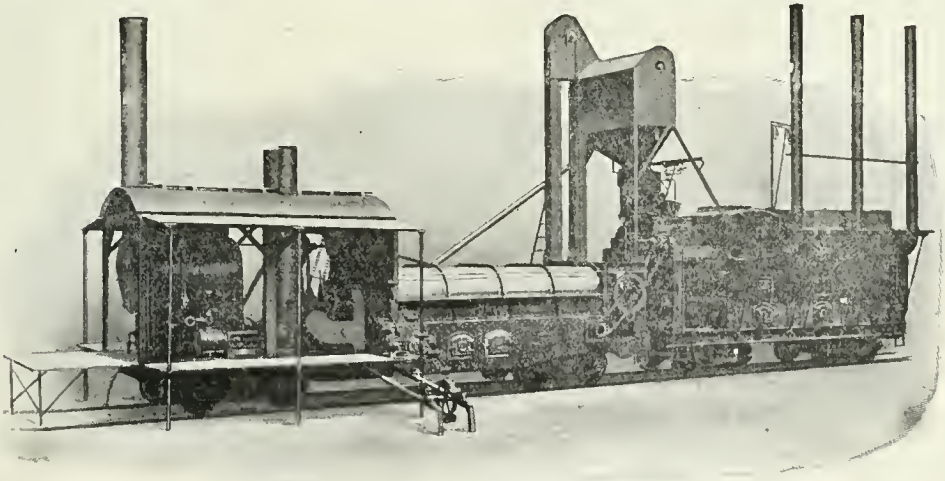
HETHERINGTON RAILWAY ASPHALT PAVING PLANTS

The product of 16 years experience in Plant Building by the originators of the first railway plant. **Still lead, are only safe railway plants made.**

THESE PLANTS HAVE NO EQUALS. WRITE FOR CIRCULARS.

HETHERINGTON & BERNER, - INDIANAPOLIS. IND.

1,500 SQUARE YARDS AND 2,000 SQUARE YARDS PER DAY.



MODEL OF 1912 TWO-CAR PLANT.

The initial cost of concrete sidewalk construction is sometimes higher but more frequently lower than other forms of prominent construction. That which makes concrete walk construction appeal, however, is the fact that when once laid it incurs but little maintenance expense, and the money previously expended for that purpose is thus diverted into the construction of more sidewalks of the same durable type.

The contractor is vitally interested in the rapidly increasing popularity of the concrete walk, as he can obtain materials near at hand permitting him to lay same at a profit to himself. In our work, we use those types of mixers which are most handy to use, and which are inexpensive from a standpoint of operating cost. On many of our jobs we use three men in putting down sidewalks, and can put down three times as much yardage with a "Standard" mixer in the same length of time, as we used to by hand. Then we do better work, save one-tenth amount of cement formerly required, and there are no mixing boards or boxes to move from job to job and no big amount of cleaning up to do after each job. Our "Standard" mixer differs from all other batch mixers in the important feature of being built low so that it can be charged directly from barrows, requiring only slightly inclined runways, instead of being high above the ground, necessitating the use of some form of mechanical charging device.

While the "Standard" mixer is appropriate for use on different kinds of work, we believe that it is particularly suitable for sidewalk work, as it not only runs between the forms in a nice shape, but it has no charging elevator, and is therefore more portable than any other batch mixer of equal capacity.

The charging platform is attached to the truck and with the inclined runways, is portable with the machine. This entire outfit is very simple and consists of few working parts, with no unnecessary weight and for this reason it can be quickly moved on the job by manual labor or drawn by one or two horses, depending upon the size and the equipment, and is ready for operation as soon as it arrives on the job.

The "Standard" mixer is so designed that it discharges high above the ground, affording ample clearance for barrows or carts. It is always under perfect control, and the batch may be discharged in wheelbarrow loads or as a unit as desired.

The material from the barrow is charged thru the large opening into the drum very quickly. In charging the drum it is preferable to put water in first, then a barrow of stone or gravel, to be followed with a barrow of sand. The cement can be preferably placed on top of the sand and both dumped together. A final barrow of stone follows the sand and cement. This method, of course, is based on the one bag batch.

By charging the mixer in this manner it is only necessary to rotate the drum two or three revolutions after the last barrow of material is delivered to the mixer before the batch is ready for discharging. This is due to the fact that the aggregates are being mixed during the process of charging and it is only necessary to thoroly mingle the last barrow load with the other material.

Trade Publications

The Semet-Solvay Co., Syracuse, N. Y., issue a handsomely illustrated booklet on "Solvay Protective Points" for painting structural steel.

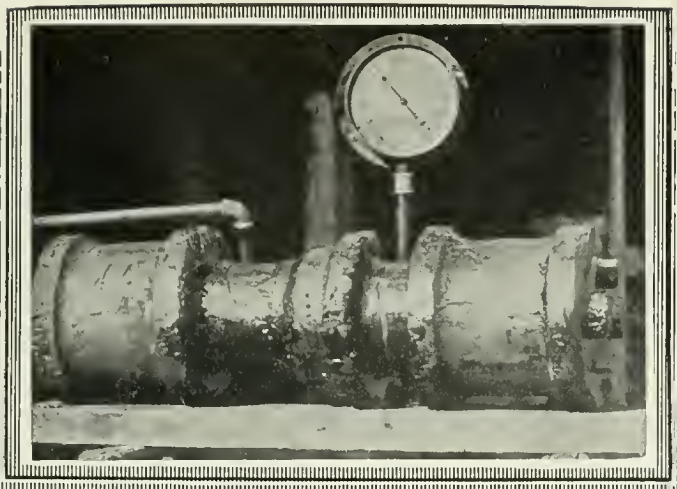
The Lehigh Portland Cement Co., issues "The Lesson of the Floods," to show the greater resistance of reinforced concrete bridges and the destruction of steel bridges, which, barring two or three errors in names of bridges and of engineers, is a convincing proof of the superiority of modern construction, especially with concrete materials.

Case road machinery is the subject of a new booklet of the J. I. Case T. M. Co., Racine, Wis., sbowing their road rollers, convertible into road spikers and hauling engines, road graders and levelers, engine tenders and road sprinklers, and rock crushers, elevators, screens and bins.

The Universal Portland Cement Co., publishes a very comprehensive booklet of 96 pages on concrete pavements, sidewalks, curb and gutter, which is fully illustrated.

The Brown Hoisting Machinery Co., Cleveland, O., will send on request Pamphlet I on Brown hoist locomotive crane with supplement showing equipment with lifting magnet; also circulars on Brown hoist buckets for all kinds of contract work, and catalog E of Brown hoist buckets and tubs.

The Universal Portland Cement Co., has issued quite a complete book of 224 pages with 159 illustrations on "The Concrete House and its Construction," which it will send on receipt of $1.



JOINTITE withstanding a pressure of 400 lbs. per square inch. End plugs and joints sealed with JOINTITE.

JOINTITE

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IMPERVIOUS JOINTING COMPOUND

FOR SEWER PIPE

FLEXIBLE
ADHESIVE
ECONOMICAL
WATERPROOF

LABOR SAVING
EASILY HANDLED
PERFECT INSULATOR
ACID AND SOIL PROOF

—Does not take fire readily upon heating. —Will not sputter or fly in wet trench work. —Requires no calking. —Roots of trees cannot work through JOINTITE. —Lines filled with JOINTITE can be backfilled immediately after joints are poured.

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108 S. La Salle St. CHICAGO.
149 Broadway NEW YORK.

SETS AS SOON AS POURED

NO SKILLED LABOR IS REQUIRED

CONTRACTING NEWS

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Cleveland, O.—Aug. 20, until 11 a. m., for the improvement of Kinsman No. 5 road, Orange township. John F. Goldenbogen, clerk of county commissioners.

Cleveland, O.—Aug 16, until 11 a. m., for the improvement of the Emery road from Warrensville township. Certified check $1,000, made payable to Cuyahoga county. John F. Goldenbogen, clerk of county commissioners.

Crookston, Minn.—Until Aug. 12, for paving portions of North Broadway and East Seventh street with westrumite asphalt macadam, approximately 9,861 square yards. A. M. Childs, city clerk.

Oneida, N. Y.—Until Aug. 19, the board of public works will open bids for the construction of 12,350 feet of improved road at Kenwood in the first ward, the road to extend from the county line bridge near Kinsley Corners southward to a point in front of the Oneida Community Home building.

Toronto, O.—Until Aug. 17, for the improvement by grading, draining, curbing and paving of Daniels street, Loretta avenue, West Main street, River avenue and Third street. Separate bids must be made on each street. Certified check, $500. J. P. Kelly, village engineer; James Conner, village clerk.

Towson, Md.—Until Aug. 14, for construction of a section of State highway on the Warren road, between York turnpike and the Franz store, length 1.39 miles. Estimated cost, $9,100. E. Stanton Basley, secretary of county highway commissioners.

CONTRACTS AWARDED.

Birmingham, Ala.—The Alabama Paving Co. was awarded contract for the paving of Fourteenth street with brick. Bid, $16,718.

Bremen, Ind.—Contract for 15,000 square yards of paving has been awarded to the Northern Construction Co., of Elkhart, Ind., at $1.70 per square yard.

Connersville, Ind.—Contract for paving twelve streets with cement was awarded to Wm. Coin, of Frankfort, at $48,000.

Elizabeth, N. J.—The Standard Bitulithic Co., 50 Church street, has been awarded a paving contract at approximately $100,000.

Glencoe, Ill.—Contract for paving Railroad and Milton avenues with brick has been awarded Wm J. Walter, local contractor, at bid of $15,239.

Lonoke, Ark.—The contract for the construction of 25 miles of macadam road in Road District No. 4 was awarded the T. H. Bunch Commission Co., of Little Rock, at bid of $91,900.

Milwaukee, Ore.—The Montague-O'Reilly Co., of Portland, was awarded contract for the paving of Front street with asphalt, at $40,000.

Olathe, Kan.—The contract to macadamize 1½ miles of road on the Strang line has been awarded Maley & Kelly, Kansas City, Mo.

Reading, Pa.—J. K. Faust & Son, local contractors, were awarded the contract for various street improvements at approximately $30,000.

Yonkers, N. Y.—The following contracts have been awarded: For paving Warburton avenue, to Kearns & Hart, at $98,760; for paving South Broadway, to the Harlem Contracting Co., at $35,055, and for paving Ludlow street, to Warren Bros., at $23,012.

BIDS RECEIVED.

Los Angeles, Cal.—The following bids were received by the board of public works for excavating 145,000 cubic yards in Harbor boulevard, from Palos Verdes to Fifth street: Russell-Greene-Foell Co., $46,980; Shattuck-Edinger Co., $52,200; Occidental Construction Co., $58,000; Richard Rothwell, $92,800. On an alternative proposition of excavating 292,000 cubic yards, the following were received: Shattuck-Edinger Co., $93,440; Occidental Construction Co., $131,400.

New York, N. Y.—Bids for constructing about 30 miles of bituminous pavement and 3 miles of waterbound macadam pavement on the highways around the Ashokan Reservoir in the towns of Olive, Marblehead, Hurley, Woodstock and Kingston, Ulster county, were received by the board of water supply, July 22, as follows: State Highway Construction Co., 233 Broadway, New York, $669,000; Winston & Co., 11 Pine street, New York, $746,000; John E. Consalus and Horton Bence, State street, Albany, $696,000; Borough Asphalt Co., and Cannon Engineering Co., Metropolitan avenue, Brooklyn, N. Y., $719,000.

CONTEMPLATED WORK.

Bakersfield, Cal.—$2,500,000 bonds have been voted for the improvement of highways in Kern county. The work includes about 327.5 miles of roads which will radiate from Bakersfield, and will also connect with the state highway, which runs through Bakersfield. C. R. Summer is chief engineer.

Joliet, Ill.—The city council has passed an ordinance for the repaving of Herkimer street from Jefferson to Clay street with asphalt. Estimated cost, $12,674. C. D. O'Callahan, city engineer.

Seattle, Wash.—The city council has ordered the following street improvements, and bids will be asked: Grading Fourteenth avenue, N. W., estimated cost, $34,390; grading Orchard street, estimated cost, $82,120; resurfacing West Sixtieth street, estimated cost, $19,918, and paving Thirty-fourth street, N. W., estimated cost, $7,072.

SEWERS.

BIDS REQUESTED.

Appalachia, Va.—Bids will be received by E. A. Collins, city recorder, until Aug. 19, for constructing a sewer system here, to include about 28,000 feet of tile pipe.

DeKalb, Ill.—Until Aug. 25, for constructing approximately 16 miles of tile pipe sewer, 8 to 24-inch, with 500 manholes and sewage purification works. M. J. Henanghan, president board of local improvements.

Newark, N. J.—Sept. 9, until 2 p. m., for construction of Section 3 for the outfall pressure tunnel beneath portion of Jersey City, Bayonne and Newark Bay. Approximate quantities, Section 3. All bids will be compared on the basis of the engineer's estimate of quantities of work to be done, as follows: Item 1—Earth or rock excavation and refilling in tunnel, for 144-inch circular concrete sewer, between Station 0-00 and shaft near Station 20-00, including excavation and refilling of all shafts, etc., 2,000 linear feet. Item 2—Earth or rock excavation and refilling in tunnel for 144-inch circular concrete sewer, on low level line across Newark Bay, including excavation and refilling of all

Asphalt Macadam Pavement, La Crosse, Wis.
Coostructed with Sarco Asphalt Binder No. 298.

If you see the SARCO label on the drum, that's as far as you need to look. None but absolutely perfect Asphalts are shipped under that label.

The following is what the *La Crosse Leader Press* has to say of the SARCO Macadam Pavement in La Crosse, Wisconsin:

> **"Shore Road Completed.**—The road along the shore, from Peal to Jay streets in the New Riverside Park, is practically completed, and scores of automobilists have taken advantage of the improvement to make spins along the river front. The smooth stretch of asphalt, just at the water's edge, is one of the most impressive stretches of highway which can be found anywhere along the upper Mississippi."

This type of pavement is ideal for Country Roads and streets in the residential part of the city where traffic is light.

SARCO Asphalt Binder No. 298 is refined especially for Asphalt Macadam Pavements. Specify it and you need have no fear of the results you will obtain.

Specifications and data on request.

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Standard Asphalt and Rubber Co.

137 So. La Salle St. CHICAGO.

shafts, etc., 9,020 linear feet. Item 3—Earth or rock excavation and refilling in compressed air, on high level line across Newark Bay, for 144-inch circular concrete sewer, including furnishing and use of full circumferential metallic plated and anchor bolts, and including the excavation and refilling of all shafts, etc., 9,020 linear feet. Item 4—Concrete, masonry, in tunnel, shafts and effluent controlling chamber of portland cement mortar, including all appurtenant work, 35,000 cubic yards. Item 5—Concrete masonry in compressed air tunnels and shafts, made with portland cement mortar, for high level tunnel across Newark Bay, including all appurtenant work, 25,000 cubic yards. Item 6—Steel reinforcements for concrete in place, 40,000 pounds. Passaic Valley sewerage commissioners. John S. Gibson, clerk, Essex building, Clinton street, Newark, N. J.

Washington, D. C.—Aug. 19, until 2 p. m., for construction of a sanitary sewer system for Platt National Park, Sulphur Springs, Oklahoma. Certified check, $15, for safe return of plans and specifications. Plans may be examined at office of mayor of Sulphur and office of superintendent of Platt National Park. Address proposals to Secretary of Interior, Washington, D. C.

BIDS RECEIVED.

Yonkers, N. Y.—Bids for constructing a sewage settling, reducing or screening plant at the intersection of the Bronx Valley sewer with Tibbett's brook, Yonkers, were received by the Bronx Valley sewer commission, White Plains, July 12, as follows: On commission's plans and specifications: William Horne Co., 37 East Twenty-eighth street, New York, $267,380; J. E. Dawson, Yonkers, N. Y., $282,879; John P. Bonney & Co., 45 York street, Brooklyn, N. Y., $284,-897; Phoenix Construction Co., 41 Park Row, New York, $327,423; Hugh Nawn Contracting Co., 200 Fifth avenue, New York, Cow Bay Waterproofing, $329,419; Gunite Waterproofing, $318,561. On alternate plans and specifications: Molloy & Murray, Yonkers, N. Y., without sterilization, $196,988; with sterilization, $219,968.

CONTRACTS AWARDED.

Geneva, Ind.—The contract to lay about 7,218 feet of 10 to 36-inch pipe sewers has been awarded to Meyers and Richards, Decatur, Ind. Bid $18,500.

Houston, Tex.—Contracts for constructing lateral sewers in the South End have been awarded by the city commissioners as follows: In Rusk avenue, to F. E. Horton, Houston, at $11,722; in Dallas avenue, to the Collins Plumbing Co., Houston, at $25,-898; in Bell avenue, to the same firm, at $22,961.

Muscatine, Ia.—The contract to construct sewers in Subdistricts 23, 24, 25 and 26 of Main District I, has been awarded to R. K. Smith, Muscatine, as follows: 23, $4,056; 24, $3,386; 25, $2,778; 26, $1,684. The other bids were A. Korneman, $4,117, $3,466; 25, no bid; 26, 1,684. J. H. Seldon, $4,298, $3,-773, $3,342, $1,870. D. E. Keuler, $4,105, $3,411, $2,815, $1,704. Independent Construction Co., $4,213, $2,607, $2,918, $1,793.

Oskaloosa, Ia.—The contract to construct 7,000 feet of 12 to 15-inch vitrified sewers here has been awarded to the Independent Construction Co., Davenport, Ia., at $28,-379. The other bids were: Black Hawk Construction Co., Waterloo, Ia., $30,040; Lytle Construction Co., Sioux City, Ia., $29,227.

Polytechnic, Tex.—The contract to construct a sewer system here has been awarded to A. T. Muller, Dallas, at $14,950. Plans for the system were prepared by Nagel & Peterson, consulting engineers, Muskogee, Okla.

WATER WORKS.

BIDS REQUESTED.

Herkimer, N. Y.—Until Aug. 12, for two 150-h.p. boilers set upon foundations at pumping station, also at same time for a perforated radial brick chimney 125 feet high. Eugene P. Parsons, clerk of public service.

Weldon, N. C.—Until Aug. 20, for construction of a water works and sewer system. W. C. Riddick, consulting engineer, West Raleigh, N. C.

CONTRACTS AWARDED.

Marion, N. Y.—The contract to construct a water system here has been awarded to Charles R. Lewis, Illion, N.Y., at $23,023. The other bids were: W. W. Chadsey, Schenectady, $27,667; A. Dancey Contracting Co., Fairport, $25,100; S. Soper & Son, Seneca Falls, $24,227; Fischette Bros., Clyde, $24,845; Huchinson & Van Ostrand, Newark, $27,614; Patrosino Bros., Clyde, $25,173. The contract involves the construction of four miles of 6 and 8-inch cast iron pipe line, a pumping station and storage reservoir. Plans were prepared by H. C. Kittredge, consulting engineer, Rochester, N. Y.

Neligh, Neb.—The contract to furnish and erect a triplex pump of 500,000 gallon capacity, a brake test fuel oil or distillate engine and a 10,000-gallon steel storage tank, has been awarded to the Alamo Engine & Supply Co., Omaha, Neb.

Olivet, Mich.—W. L. Dillon, of Ft. Wayne, Ind., was awarded the contract for the installation of the waterworks system. Bid, $14,500.

Pierre, S. D.—The contract to construct a rubble concrete dam across Hilger's gulch on Capitol avenue, in the city of Pierre, has been awarded to Josef Stainer, Pierre, at $8,351. The other bids were: Ward & Weighton, Sioux City, $10,605; R. B. Airey, Pierre, $9,988; Pierre Cement & Construction Co., $11,295.

Randolph, Mass.—The Randolph & Holbrook Water Works Co. has awarded a contract to the Epping-Carpenter Co., Pittsburgh, Pa., for furnishing a high duty Corliss cross-compound condensing pumping engine.

BRIDGES.

BIDS REQUESTED.

Cleveland, O.—Aug. 20, until 11 a. m., for the construction of bridge work per Report No. 3165, concrete steel bridge on the Lee road, Warrensville township. Certified check, 10 per cent. of engineer's estimate, payable to Cuyahoga county. John F. Goldenbogen, clerk of county commissioners.

Cleveland, O.—Aug. 16, until 11 a. m., for furnishing labor and material for construction of the super-structure of the Detroit Superior bridge. Certified check, $10,000, payable to the treasurer of Cuyahoga county. Certified check or currency for $25 must be deposited as guaranty for return of plans. John F. Goldenbogen, clerk of board of county commissioners.

Defiance, O.—Aug. 11, until 2 p. m., for furnishing all material and labor for the construction of a concrete flat top bridge, Section 3, Farmers township, abutments for bridge between Secs. 10 and 11, Hicksville township, and for wall at south abutments of Francis street bridge, this city. S. I. Gruner, county auditor.

Fernandina, Fla.—Until Aug. 13, for furnishing material and constructing a plate girder draw bridge 149 feet, also 600 feet of pile and timber approaches for same, price to be per lineal foot. Board of county commissioners.

Coldwell Lawn Mowers

Near the first hole, Pelham Bay Park links, N. Y.

Two Mowers in One

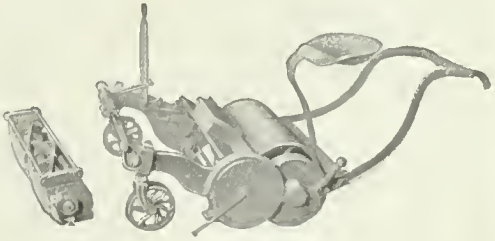
You get practically two horse mowers in one with Coldwell Demountable Cutters. These cutters are removable at will, like the blade of a safety razor, and two or more go with each machine.

If one cutter needs sharpening or repair, it takes less than a minute to remove it from the frame and attach another.

No waste of time sending the whole mower to the shop. No heavy freight charges.

Send for leaflet giving full description and prices, together with practical booklet on The Care of Lawns.

The Coldwell Company makes lawn mowers in 150 different styles and sizes. The Coldwell Combination Roller and Motor Lawn Mower is the best and most economical mower ever made for use on large stretches of lawn.



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Kansas City, Mo.—Aug. 19, until 2 p. m., for construction of the Twelfth street traffic way viaduct. Each bid must be accompanied by a certified check equal to five (5) per cent. on the first ten thousand dollars of the bid, and two and one-half (2½) per cent. on all sums above ten thousand dollars ($10,000), payable to M. A. Flynn, city comptroller, conditioned that the successful bidders will enter into a contract with Kansas City for said work. Work to be completed within fifteen months from date of contract. Bids must be enclosed in a sealed envelope, and addressed to E. J. McDonnell, secretary of the board of public works, City Hall, Kansas City, Mo., endorsed on outside of envelope, "Bids on construction of Twelfth street traffic way viaduct." E. J. McDonnell, secretary board of public works.

Stenvenville, O.—Aug. 19, until noon, for furnishing labor and material necessary for construction of the substructures for Bridge No. 17, in Saline township, known as the Idding's bridge, and for Bridge No. 28, in Island township. Also for steel superstructures for same. Bidder may submit plans with bids on steel superstructures. Certified check, $300, required with each bid. John L. Means, county auditor.

BIDS RECEIVED.

Marysville, O.—Bids were received at the office of the county auditor on July 12, as follows for the Essex bridge, Jackson township: The Capitol Const. Co., Columbus, O., $6,800; Croghan Const. Co., Fremont, O., $6,194; E. M. Scully, Columbus, O., $6,923; Home Engineering Const. Co., Canton, O., $7,000. For the Shields bridge, Mill Creek township: E. M. Scully, $6,370; Croghan Const. Co., $6,450; Standard Engineering Co., Toledo, $6,486; The Capitol Const. Co., $6,492; Home Engineering Const. Co., $6,500. For the Kennedy bridge, Taylor township: Home Engineering Const. Co., Canton, O., $5,787; The Capitol Const. Co., Columbus, O., $5,999; Croghan Const. Co., Fremont, O., $6,040, and for the Thompson bridge, Mill Creek township: Croghan Const. Co., Fremont, O., $4,549; The Capitol Const. Co., Columbus, O., $3,495; Home Engineering Const. Co., Canton, O., $3,550.

Wilmington, Del.—Bids for the construction of the Third street bridge over the Christiana river at Wilmington, were received as follows: Superstructure: Strobel Steel Construction Co., Chicago, Ill., $126,514; Penn Bridge Co., Beaver Falls, Pa., $126,900 and $127,800; Pennsylvania Steel Co., Philadelphia, Pa., $137,000 and $139,000; Nelson-Meredith Co., Chambersburg, Pa., $136,000; James I. Vincent, New York, N. Y., $110,000. Substructure: Nelson-Meredith Co., $87,100; Atlas Bridge Co., Wilmington, $75,592; McLean Construction Co., Baltimore, Md., $102,250; Girard Construction Co., Philadelphia, $74,227.

LIGHTING.

CONTEMPLATED WORK.

Batesville, Ind.—The installation of additional equipment in its power plant is under consideration by the Batesville Electric Light and Power Co. A. W. Romweber, secretary.

Bryan, O.—Plans are being prepared for the installation of an ornamental street lighting system, to cost $5,000.

Cedar Rapids, Ia.—Contract has been awarded the Murray Iron Works, of Burlington, Ia., for furnishing boilers for the electric light plant. Contract price, $12,868. The General Electric Co., of Ft. Wayne, Ind., was awarded the contract for the electrical supplies. Bid, $9,518.

Imperial, Cal.—The city council is considering plans for the installation of a municipal electric light plant and system. I. B. Funk is interested.

Lestershire, N. Y.—The installation of an ornamental street lighting system is under consideration by the board of trustees.

Windom, Minn.—The city council has authorized the expenditure of $15,000 for the construction of an electric light plant.

AUTOMOBILES—FIRE APPARATUS.

Dayton, O.—Bids will be received Aug. 15, until noon, for a new 1-ton or 1½-ton or 2-ton automobile truck chassis. Also for a new 1-ton or 1½-ton or 2-ton automobile truck, complete with body and top. Specifications for automobile truck body and top are on file in the office of the superintendent of buildings, Steele high school, corner of Main street and Monument avenue. Certified check 5 per cent. of bid. E. H. Herr, president board of education.

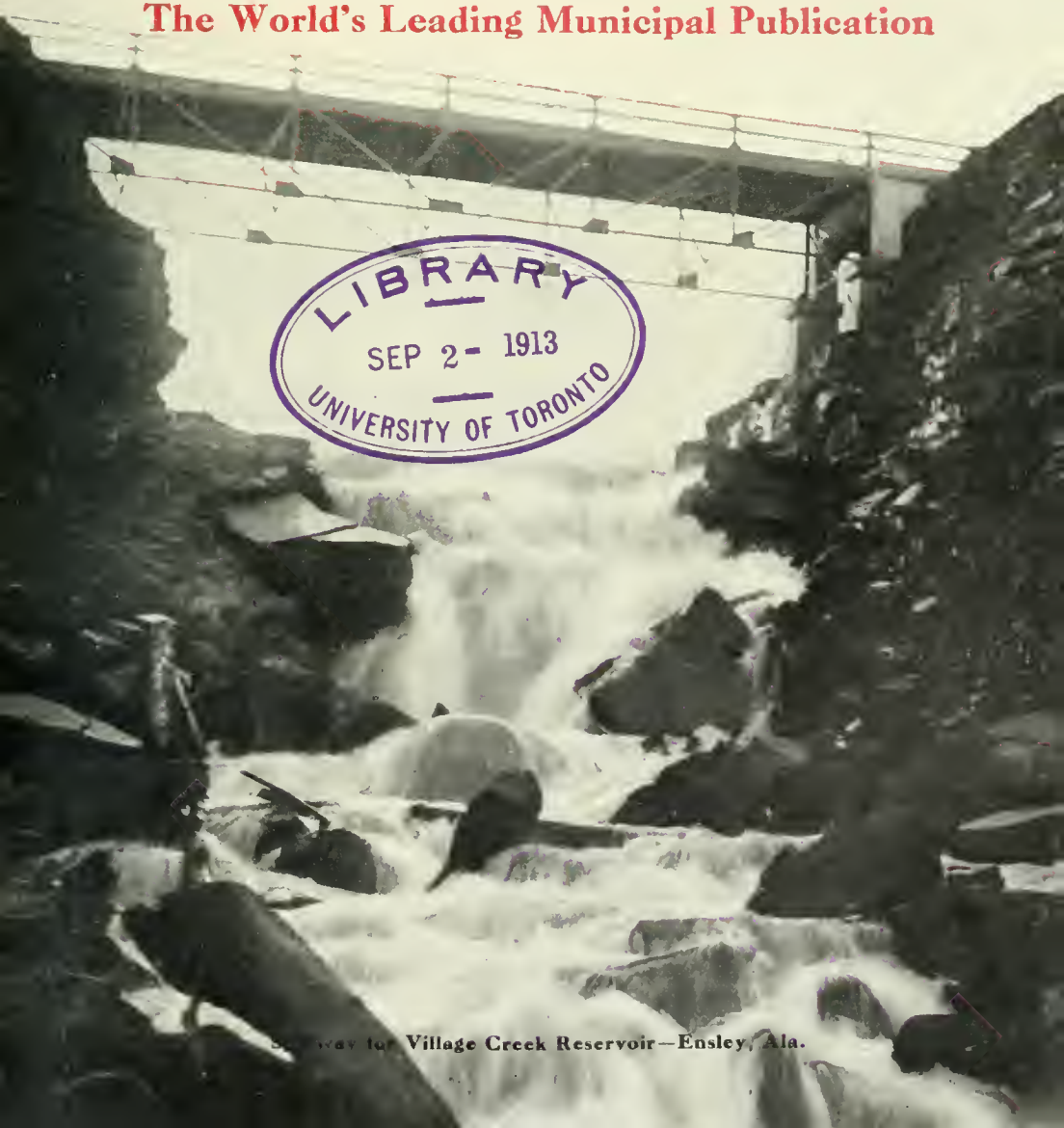
Aberdeen, S. D.—E. J. Kingsley, chief of the fire department, writes that the purchase of motor fire apparatus soon is contemplated.

Marion, O.—A bond issue of $1,200 for a motor car for fire chief and $10,000 for a combination pump and hose wagon has been recommended by Claude D. Walters, mayor.

Vol. XLV. No. 3. September, 1913. Twenty-five Cen

MUNICIPAL ENGINEERING

The World's Leading Municipal Publication



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GERMAN *dump wagon of the tilting type.*

VOL. XLV. SEPTEMBER, 1913. No. 3.

The interchanging of ideas brings men in every line of business to a higher point of efficiency. The successful man of affairs is constantly seeking the experience of others, not only in his own line of work, but in other fields. He gives freely of his own, and by so doing broadens himself. Whenever the readers of MUNICIPAL ENGINEERING *are inclined to tell us of their experiences we are glad to publish them and bring about further discussions that will be of help. Give freely of your experiences and study those of others—you may gain in the exchange.*

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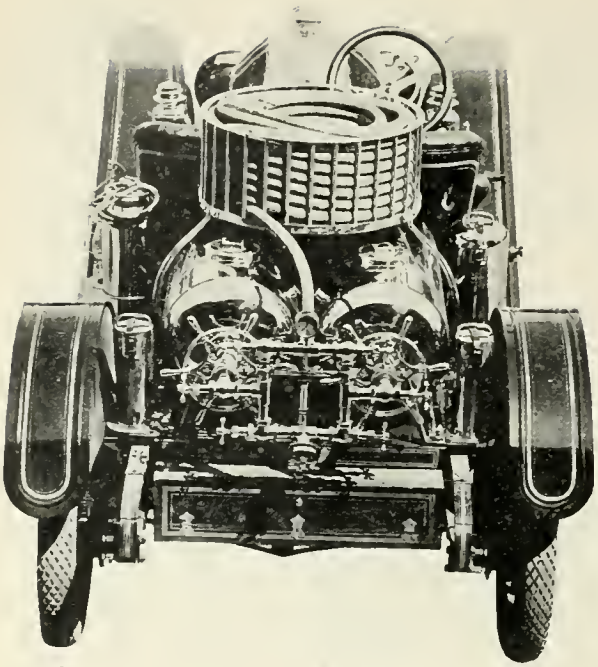


CHIEF'S *chemical wagon, 50-h.p. Kissel-Kar.*

MOTOR FIRE APPARATUS

By H. W. PERRY,
New York City

WITHIN the next ten years over $80,000,000 will be invested in motor-driven fire apparatus. The majority of this will be spent within five years. During the last eighteen months the number of pieces of motor apparatus has increased from 600 to over 2,000. There are now in use 20,000 pieces of apparatus drawn by 35,000 horses. Pittsburg is motorizing its fire department and will effect a 50% profit on the transaction. The property loss in Springfield, Mass., was $369,000 less in 1912 than in 1907. The number of motors in use between these dates was increased by 19. Isn't it self-evident that motors will eventually supplant fire horses in the U. S.? Mr. Perry has made an intimate study of this question, upon which he presents interesting facts in this article.

FIRE departments of a majority of cities in the United States will be completely motorized five years hence. Many have stopped buying horses and horse-drawn apparatus. In the light of experience and records of the remarkable economy of using self-propelled apparatus, no fire board or fire chief can feel justified in recommending future purchases of the old type of apparatus. At the annual conventions of fire chiefs, the advantages of motor apparatus and the saving it effects are the principal subjects of addresses and discussions, while the display of apparatus is entirely of the self-propelled type.

The revolution in transportation methods that was promised by the manufacturers of motor vehicles is coming about more quickly and completely in the field of fire fighting than in any other. There are good reasons why this should be the case, yet the decision of the fire commissioners of New York, Boston and other big cities to place entire dependence upon the reliability and efficiency of motor equipment should be the most convincing argument to business men

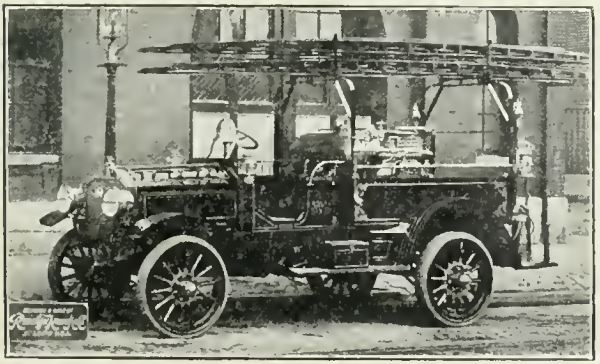
that motor trucks and delivery wagons are in a sufficiently advanced stage of development to prove satisfactory in industrial and commercial work.

SOME of the reasons for the rapid substitution of motor propelled apparatus for horse drawn and the change of attitude by fire chiefs.

It was the superior speed of the motor car that first commended it to fire department officials, but they were long skeptical of its reliability and economy. The large cities especially were very conservative toward motor apparatus. New York, Chicago, Boston, Philadelphia and other big cities were notoriously slower to adopt the motor chemical and hose car and the motor fire engine than were hundreds of smaller cities and villages. Within the last year or two, however, their attitude has changed completely, and they are taking the lead in substituting motor apparatus for horse-drawn equipment. New York last year had fifty-nine pieces of apparatus, including chiefs' and deputies' cars and runabouts, and the budget for 1913 included an appropriation for the purchase of eighty-seven additional pieces. More than a score of new fire houses, to be completed as soon as possible, were designed with a view to housing motors instead of horses, or after the horses have been superseded. Fire Commissioner Johnson told the writer fully two years ago that the New York fire department would be completely motorized as rapidly as possible and that probably within five years the last of the horses would be sold. This means the displacement of 1,500 horses, and an expenditure of $2,500,000 in the gradual conversion to motors.

Paris has advanced much further in this direction than American cities, the municipal council of the French capital having decided to abolish horses from all municipal service. Following a test of various types of motor vehicles by the street cleaning department last year, the authorities have recently put into service a large number of combination street watering and sweeping machines and electric garbage wagons. In five of the twenty city wards the horse had been displaced by these machines up to last April, and other wards had made a partial change. Motor fire apparatus has been used for years in most of the capitals of Europe, particularly Paris, Berlin, London, Glasgow, Dublin, Vienna and Rome. Doubtless it will be some years before American cities reach the advanced position of Paris, but it is certain that in time all big cities will abolish horses from municipal service, and some will prohibit or restrict their use by private citizens.

Pittsburg is motorizing her fire department rapidly, a process that John H. Dailey, director of the department of public safety, estimates will take about three years to complete. He predicts that there will hardly be a city of any size in the United States in five years where fire apparatus is not mostly self-propelled. His prediction is based on personal experience with the efficiency and



A TYPE of motor apparatus which has saved property owners many thousands of dollars. It is speedy and equipped with necessary ladders and chemical tanks to extinguish small fires before they reach a point of doing much damage. Built by Robinson Fire Apparatus Co.

economy of motor equipment. Figures compiled from records of the cost of maintaining and operating the present motor apparatus indicate that the first year's saving in expense will be almost double the cost of complete motorization. The cost of keeping a chemical and hose car he found to be approximately $55 a year, as compared with $600 a year for each piece of horse-drawn apparatus. The city maintains 131 pieces of apparatus and keeps 25 extra horses, equivalent to 12 more pieces, making a total of 143, not including runabouts and horses used by the chief engineer and district chiefs. At $600 a year these cost $85,800, while an equal number of motor pieces at $55 would cost $7,865, thus effecting a direct saving in maintenance and operation of $77,935 a year. To this is added $7,000, now lost each year through death of horses, and about $143,000 saved in salaries of 116 men, who will not be needed in the department after complete motorization, as that number now do nothing but take care of horses. Twelve engine houses now in use can be dispensed with after motorization without decreasing the efficiency of the department, in the opinion of the director, because of the speed and increased radius of the machines. It is estimated that these pieces of property can be sold for at least $500,000. All these savings aggregate $727,000, while the cost of motorizing will be about $500,000, leaving a profit of nearly 50 per cent. on the transaction.

POWERFUL *three-stage centrifugal turbine pump in use in Tacoma, Wash. Capacity, 1,000 to 1,200 gallons per minute. Manufactured by The Seagrave Co.*

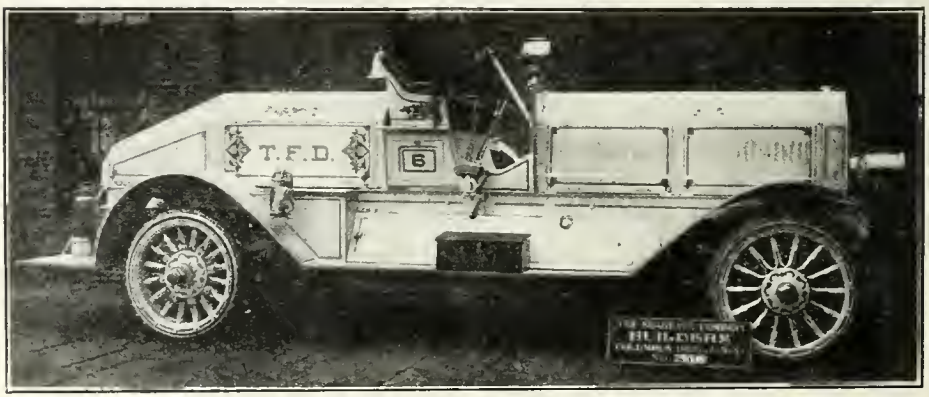
CITY OFFICIALS *who continue to buy horse-drawn apparatus are not guarding the best interests of taxpayers.*

Upon such a showing as this it is plain that any fire committee or board of safety that continues to sanction the purchase of horse-drawn apparatus without a careful investigation of power equipment is remiss in its obligations to public office, one of which is to conduct its department with the utmost economy consistent with maximum efficiency.

Boston's attitude is shown by the recent request of her fire commissioner for an appropriation of $150,000 a year for two years for the purchase of six triple combination motor pumping engines, six combination motor chemical and hose cars, and six combination motor chemical and ladder trucks to replace the present horse-drawn, and two additional two-wheeled tractors and five four-wheeled tractors for horse-drawn ladder trucks.

Chicago is motorizing rapidly. A year ago she had two motor fire engines, several chemical and squad wagons and seven chiefs' and assistants' cars. Thirteen chemical and squad machines have been added since then. The Chicago Fire Insurance Patrol has recently bought six combination chemical and hose cars and five patrol trucks for carrying men and protective tarpaulins for salvage work.

The effectiveness of the motor chemical



for fire work has been proved in Chicago, where in nine cases out of ten the chemical engines have the fire out before the horse-drawn steamer arrives at the scene. On one occasion at least one of these had put out a fire and returned half way to the fire house before it met the steamer with horses on the dead gallop just answering the alarm.

COSTS *which prove the great savings effected in one city.*

Springfield, Mass., was one of the first cities in the country to adopt motor apparatus and her experience with it has been so satisfactory that the board of aldermen made an appropriation last May of $24,000 for additional motor equipment. This was in addition to $12,000 in the municipal budget for the same purpose, making $36,000 available this year.

Thousands of dollars are being saved every year by the use of motor apparatus in the Springfield department, as shown by a table of comparative costs of upkeep of horse and motor equipment prepared by the board of fire commissioners for the year ended March 31st, last. The figures are given below.

HORSE-DRAWN APPARATUS.

	Runs.	Regular upkeep.
Truck No. 8	107	$620.42
Hose No. 10	143	427.94
Totals	250	1048.36
Averages	125	524.18

This shows an average saving of $362.29 a year on each piece of motor apparatus and an average of 49 more runs by the motor trucks than by the horse-drawn, while the horse-drawn hose wagon made five more than the average of 138 runs made by the motor hose trucks. The charge for alterations of motor truck No. 1 was for changing the location of the batteries and other improvements, and the charge of $625 against motor hose No. 1 was for rebuilding or completely overhauling the truck, which occurs at intervals of several years. Eliminating these charges, it is found that the average regular maintenance expense for the

MOTOR APPARATUS.

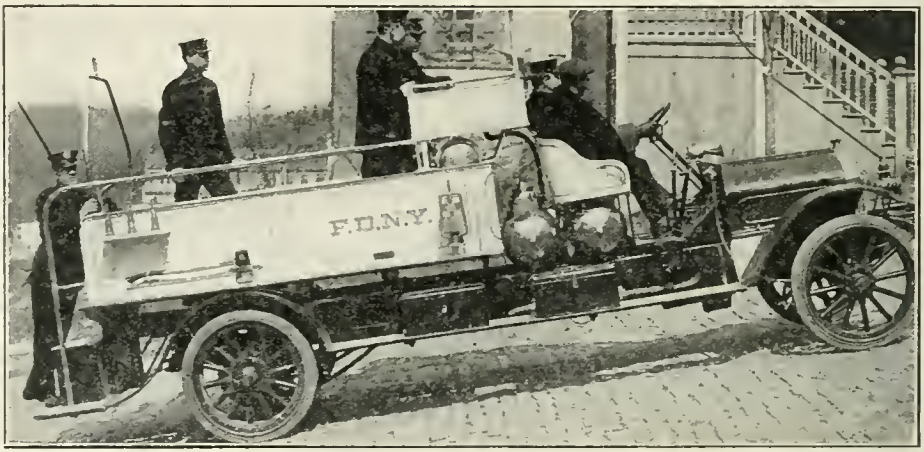
	Runs.	Regular upkeep.	Alterations.	Total.
Truck No. 1	148	$55.32	$225.00	$280.32
Truck No. 10	165	65.21	.....	65.21
Hose No. 1	192	55.71	625.00	680.71
Hose No. 7	216	31.86	.....	31.86
Hose No. 8	110	37.40	.....	37.40
Hose No. 12	109	22.17	.....	22.17
Hose No. 13	63	15.61	.....	15.61
Totals	1003	283.28	.....	1133.28
Averages	143	40.46	.....	161.89

WHITE HIGH *pressure service machine which assists the chief who has control over the amount of water pressure necessary at a fire.*

motor apparatus was only $40.46 each, as compared with $524.18 for the horse equipment.

Director of Public Safety C. W. Stage, of Cleveland, predicts that not a single horse will be in use in the Cleveland fire department five years hence. An appropriation of $45,000 is to be expended for service four motor fire engines and hose trucks, two chemical and hose trucks, one hook and ladder truck and one city service truck. The total expenditure has been $55,650.

Whereas in general haulage, such as contractors' work, the motor truck effects its greatest saving by being kept in mo-



CLIMBING *Gunboat Hill, New York, with one of the thirty-five Mack combination chemical and hose trucks which are used in this city.*

additional motor apparatus, including equipment for two new companies and flying squadrons. Eight motor vehicles are to be purchased for the fire department. A separate appropriation has been made for four motor patrol wagons for the police department.

Toledo passed an ordinance last winter providing for a bond issue of $200,000 to be used for motorizing the fire department. The sale of fire horses and displaced apparatus will add about $70,000 to this amount, making a fund that will be large enough to provide for a motor truck for the fire alarm telegraph service, several machines for the police department and cars for the electrical, building and smoke inspectors.

Some of the southern cities are fully as progressive as their northern sisters, in this direction. For example, Macon, Ga., has disposed of the last piece of horse-drawn fire apparatus. During the last three and one-half years it has put into tion as much of the time as possible, the conditions are exactly reversed in fire service, the greatest economy occurring during the idle time in the fire house. This is due to the fact that there is no depreciation or wear and tear of the apparatus and no fuel consumption in the engine house, whereas horses eat and grow old the same when idle as on the street. Furthermore, horses require a great deal more attendance at all times than motor equipment, occupy more stable room, and require storage space for feed. The motors, being faster and tireless, can protect greater areas, so that fewer fire houses and fire companies are needed. All of these effect a direct saving in the expense of the department.

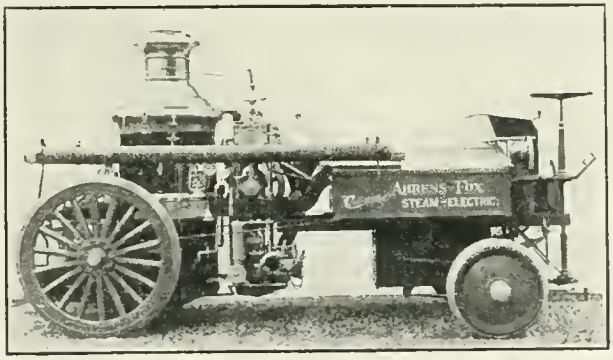
There are other economies, however, that are enjoyed by the community, but which can not readily be calculated and which do not appear in the annual reports and recommendations of the fire commissioners. One of these is the reduction of insurance rates that follows the motorizing and increased efficiency of the department in any city, and another is the actual reduction of property loss by fire resulting from the more prompt ar-

rival of motor apparatus and the extinguishing of fires before they have gained much headway.

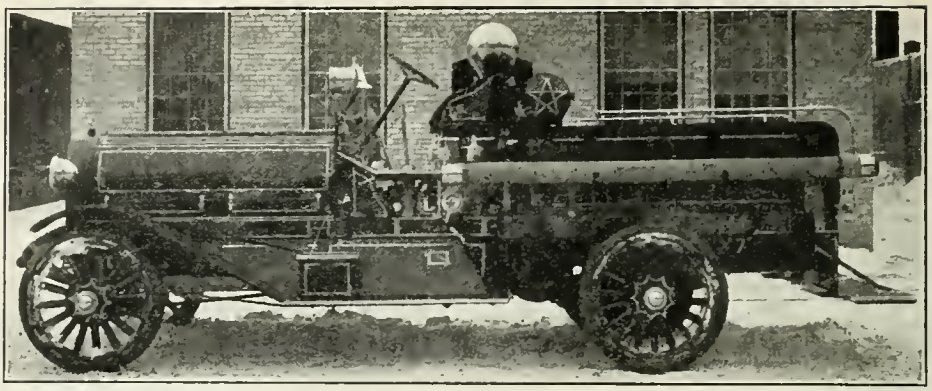
CAN ACTUAL *reduction of* $369,000 *has been made by this city as a result of the installation of nineteen pieces of motor apparatus. The result of this efficiency has been a reduction in fire insurance rates.*

A report submitted recently by the fire commissioner and chief engineer of Springfield, Mass., throws interesting light on how effectual motor apparatus really is in reducing fire loss, and why the insurance companies are willing to make substantial reductions in premium rates in cities whose departments are motorized. This report states that there are now 22 pieces of motor apparatus in the service of the Springfield department, and compares the fire loss last year with that of five years ago—1907—as follows:

Year.	Motors.	Alarms Answered	Property Loss.
1907	3	489	$535,000.00
1912	22	829	166,000.00
Difference			$369,000.00



TWO *different types of horse-drawn apparatus which have been motorized by attaching Couple-Gear electric tractors.*



NOTT *six-cylinder fire engine and hose wagon with a pump capacity of* 900 *gallons per minute against* 150 *pounds pump pressure.*

A single bad fire in 1907 accounted for a large part of the difference in property loss, yet it is evident that the motor equipment has enabled the department to take care of almost double the number of fires with greatly lessened property loss.

Economy of maintenance is of secondary importance, of course, to efficiency and dependability. But motor apparatus has now been in actual service in many cities for varying periods, and its efficiency and reliability can be testified to by so many fire authorities that there is no good ground for entertaining doubts of these points any longer. Fire Chief Kenlon, of New York, touching on this matter, made the statement that in six months the motor-drawn steamer in the metropolitan department answered nearly 500 alarms, and in no case had failed to reach the fire, in most cases in better time than the horses. As a result of this record, the department ordered 28 additional motor tractors. Fire Chief Bowker, of Passaic, N. J., in a paper before the last International Convention of Fire Engineers, reported that he had had two motor tractor ladder trucks in service for eighteen months, and not once in that period had trouble been experienced in starting when answering an alarm, and that they had always arrived at and returned from fires without any trouble or delay.

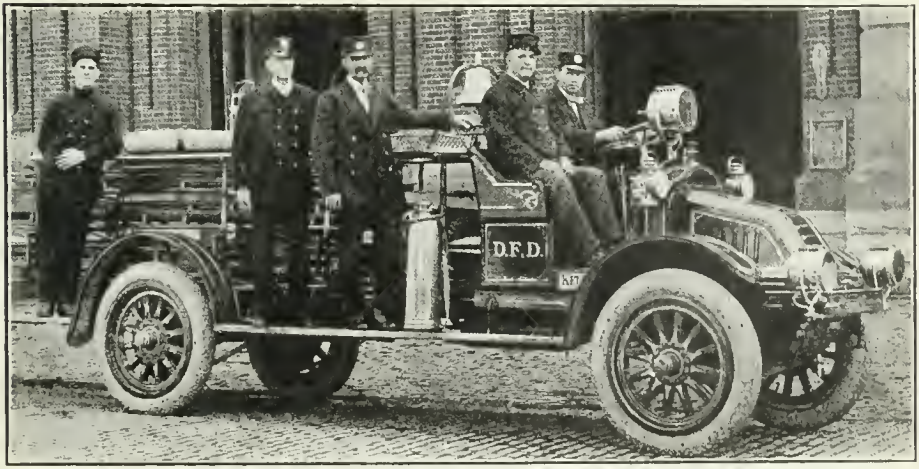
Chief Smart, of Calgary, Canada, reported to the same meeting that he had had in use for three winters a 40-h. p. squad truck and that in that time it never had been tied up and never failed to reach the fire under any weather conditions. Superiority of the motor was particularly demonstrated when streets were covered with sleet or hard-frozen snow, making them impassable for horses, but presenting no difficulties to the motor apparatus.

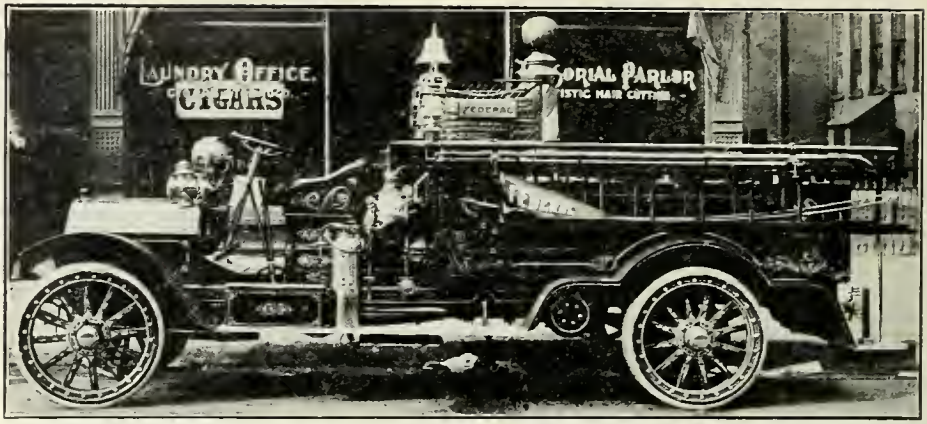
Following a continuous snowfall of 24 hours in Passaic, N. J., the department received an early morning alarm from the hill section. After returning from the fire the registering speedometer showed fifteen miles an hour, according to Chief Bowker, and this was made up hill through deep, unbroken snow.

Many fire chiefs favor motor tractors because these permit the retention of the present steamers, aerials and water towers. There is, of course, an undeniable economy in this, as the sale of present apparatus would net only a small return on the original investment. Where new equipment is to be bought for extensions of the fire service this factor does not enter. However, in the case of the fire engine, there is reluctance to abandon the steamer, with its long-proved dependability, in favor of the gasoline pumping engine. Until sufficient tests in actual service have fully demonstrated the ability of the gas-driven pump to operate at full power continuously as long as necessary, and to throw as powerful a stream and as large a volume of water as a steamer, the tractor system combines the speed

UPPER VIEW—*Garford emergency hose and chemical wagon. This type of apparatus is often used to carry firemen trained in laying out the work of the apparatus and men that follow at a slower speed. It is often possible for them to extinguish a small blaze without further assistance. Such a type is particularly valuable where the majority of the department apparatus is horse-drawn.*

LOWER VIEW—*Kelly hook and ladder equipment on a one-ton chassis in use at Delaware, Ohio.*





A VERY *completely equipped combination chemical and hose truck in use at Portland, Ore.; Attleboro, Mass.; Tupelo, Miss. Manufactured by Federal Motor Truck Co.*

and economy of motor service with the dependability of the steam engine.

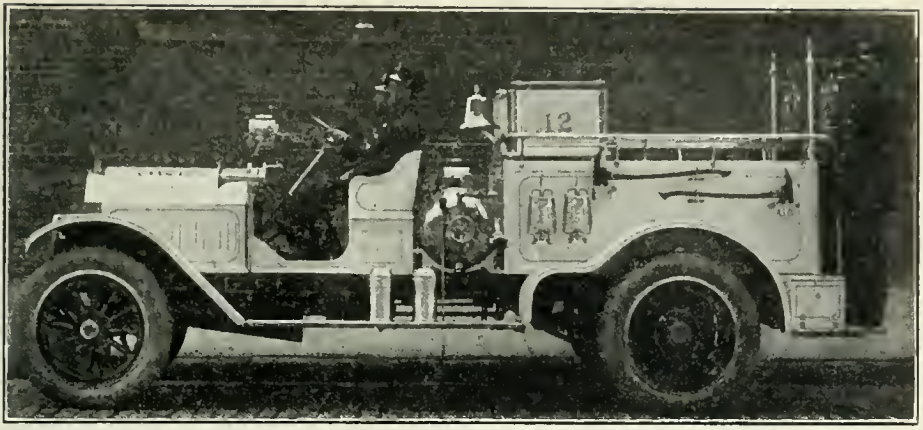
Eventually, however, the motor fire engine will demonstrate its superiority because it is lighter, faster, and more easily controlled in traffic than the cumbersome combination of a tractor element and a steam pumping engine. In the motor engine, one power plant serves the dual purpose of driving the apparatus to the fire and driving the pump to throw water upon it, whereas any system that permits retention of the steamer involves two power plants, one of which is necessarily idle while the other is working. Another disadvantage is that the motor propelled steamer does not have time to get up sufficient steam on the way to a fire to be effective at once upon its arrival, whereas a motor engine has available the full power of its engine immediately. Most of the tractors at present in successful use are of the electric type, but there have been some attempts to combine gasoline engines and steamers to form a self-propelled unit. Besides the great weight of such an outfit, there is the added element of danger in the proximity of a gasoline-using engine to the fierce open fire and dropping coals of a steam engine.

Regarding the present reliability of motor fire engines, we have the testimony of Fire Chief Magee, of Dallas, Tex., who cited one occasion when, after getting to a fire in record time, the motor pumped water for three lines of hose for 17½ hours and for one line of hose for three hours longer. Fire Chief Ballantyne, of Savannah, Ga., a city of 100,000 inhabitants, which is completely motorized with 14 pieces of apparatus, has reported an occasion when it was necessary to put seven motor pumps hub deep in new-made ground where horses could not go, at a fire on the city's water front. The motors pumped 21 streams for 8½ hours and three streams for 13 hours without any sign of trouble. All the pumps ran at full speed continuously.

FIRE engineers in their annual convention will bring forth a vast amount of valuable data.

No doubt that much more testimony on the efficiency, reliability, and economy of motor apparatus will be forthcoming at the Forty-first International Annual Convention of Fire Engineers, to be held in New York City the first week in September, and that the exhibition of apparatus will prove most entertaining and instructive.

It developed at the last convention that there were few cities of 10,000 population and over that did not possess one or more pieces of self-propelled apparatus. Since then there has been greater activity than ever before in the purchase of such



AMONG *the types of hose and chemical trucks, with which Philadelphia is equipped, is the Boyd.*

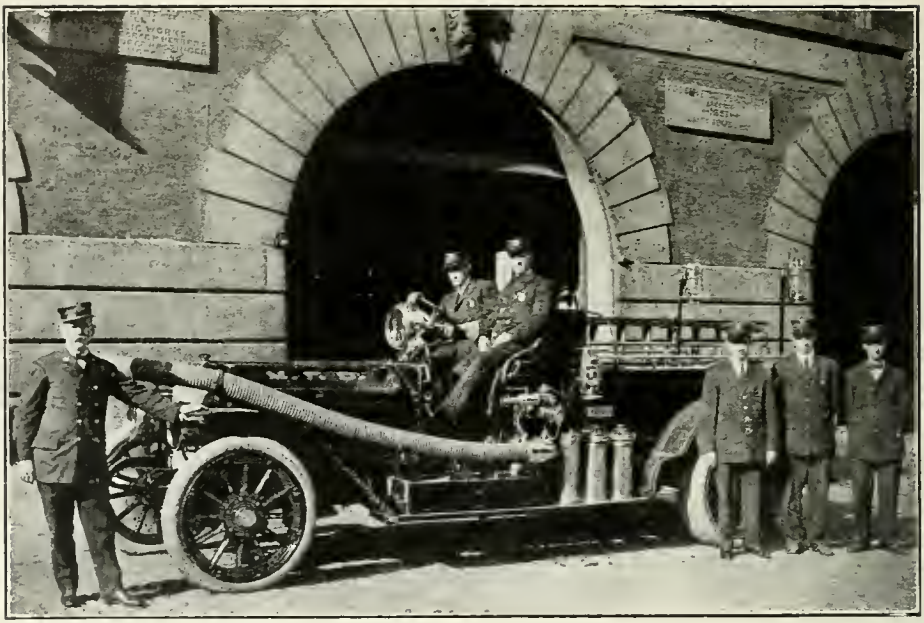
equipment. Bi-monthly records show that the number of cities buying or installing motors has run from 60 to 100. It is safe to say that at present an average of from 40 to 50 cities contract for or install one or more pieces of fire apparatus per month.

At the beginning of the year 1913 there were 629 pieces of fire apparatus in use by 180 leading American cities of 8,000 population and up, not including fire chiefs' cars and deputies' runabouts. These were classified as follows:

Combination chemical and hose trucks	257
Pumping engines	103
Triple pumpers	45
Hose trucks	47
Chemical, hose and ladder trucks.	34
Tractors	24
Aerials	20
Auxiliary trucks	85
Service trucks	14
Total	629

The number of self-propelled vehicles in these cities, including chiefs' cars and runabouts, increased from 448 in 1911 to 911 in 1912, thus more than doubling,

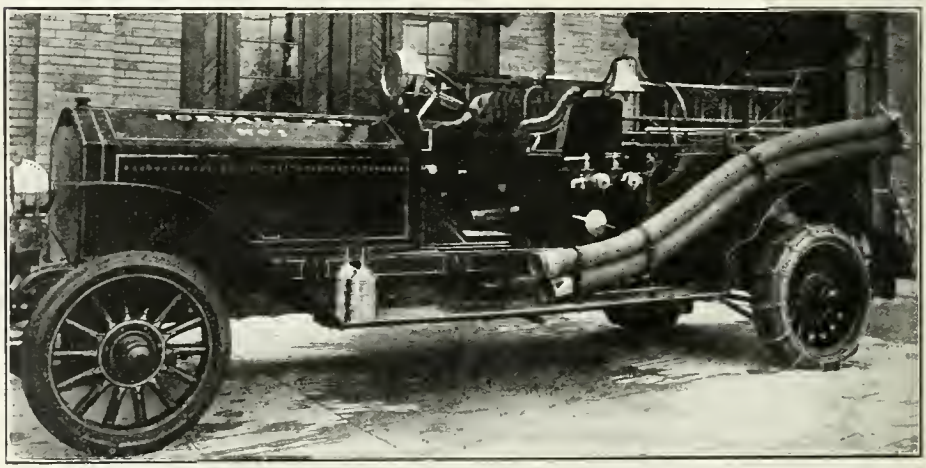
THE SPEED *of this Peerless three-ton chemical hose and ladder truck, in use at Cohasset, Mass., is restricted by ordinance to* 14 *miles per hour.*



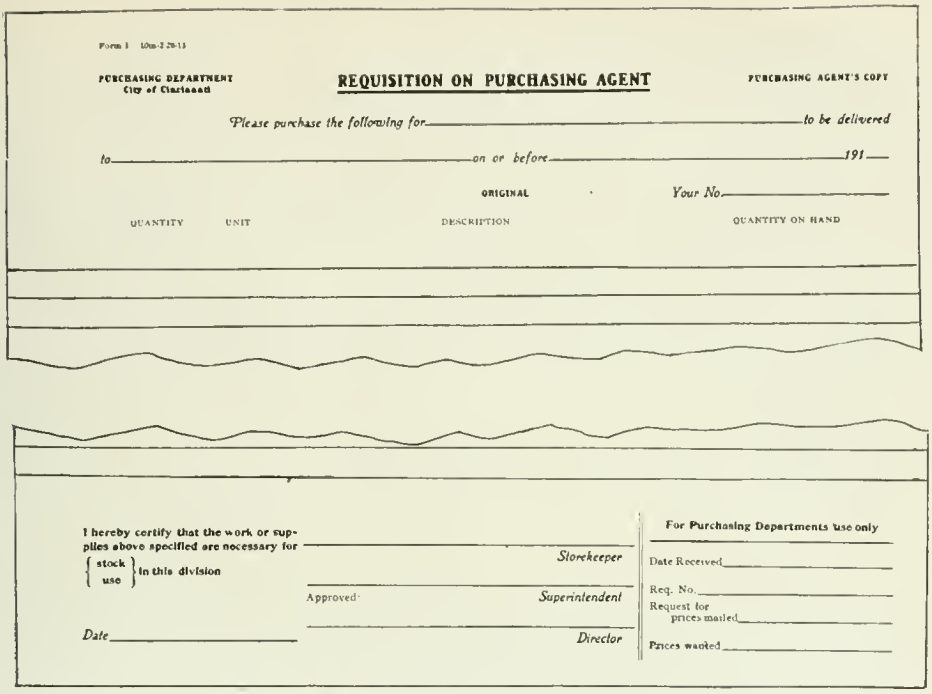
TO APRIL *tenth this American-La France pumping engine, type* 12, *in use in Memphis, Tenn., made* 133 *runs, covering* 558½ *miles in* 62½ *hours out of quarters. Chief John E. McFadden standing near front and Capt. B. O'Neil seated at the left of driver.*

while the number of pieces of horse-drawn apparatus decreased in the same period of one year from 3,689 to 3,483, or 209.

In 24 cities the average total cost per month of keeping and using a combination motor chemical and hose truck, including general repairs, new tires, gasoline and oil, was $7.70. These figures are for an average period of 18 months in service.



AMERICAN LA FRANCE *type* 15, *six cylinders,* 122-*h.p., in use at Norwalk, Ohio. Pumps* 750-950 *gallons per minute, developing with* 1¾ *S. B. nozzle a pressure of* 70 *lbs.*



Form 1 10m-2-20-13

PURCHASING DEPARTMENT
City of Cincinnati

REQUISITION ON PURCHASING AGENT

PURCHASING AGENT'S COPY

Please purchase the following for _____ *to be delivered*

to _____ *on or before* _____ *191*__

ORIGINAL

Your No. _____

QUANTITY	UNIT	DESCRIPTION	QUANTITY ON HAND

I hereby certify that the work or supplies above specified are necessary for { stock / use } in this division

_____ *Storekeeper*

Approved: _____ *Superintendent*

Date _____ _____ *Director*

For Purchasing Departments use only

Date Received _____

Req. No. _____

Request for prices mailed _____

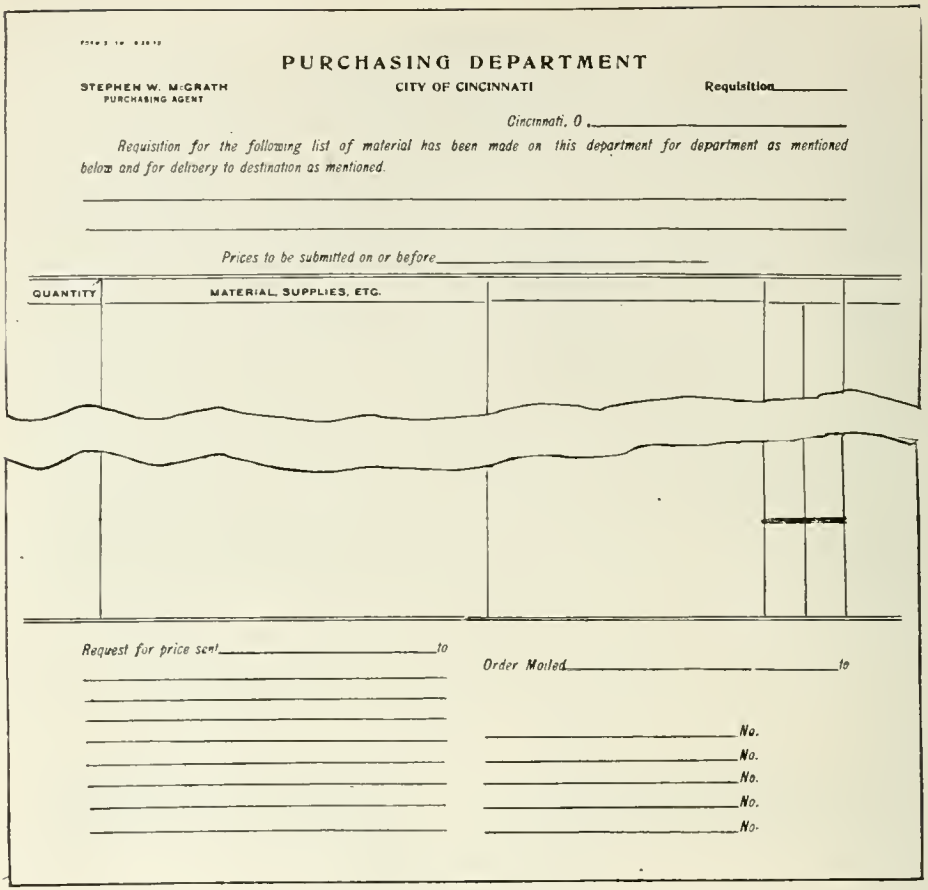
Prices wanted _____

PLATE I. *Copies of this form are in the offices of each department for which the purchasing agent buys supplies. Properly signed, this becomes a valid order for the agent to make purchases.*

CINCINNATI'S PURCHASING SYSTEM

A Compact System so Simple and Complete that Information on Any Purchase can be Secured Immediately. The Expense of Conducting the Department Is Only Two Per Cent of the Amount Purchased. The System Is Based Upon and Operated by Business Methods and Is a Model for Cities, Large or Small.

WHEN the present administration of the city of Cincinnati came into office approximately two years ago it fell heir to a purchasing department which was such in name only. The prior administrations had failed completely to make this an effective and efficient adjunct to their offices. The only records inherited by the present department were a few cards recording telephone numbers of the favored vendors of supplies. Prices were not codified; requisitions were filed in such a manner as to make the information contained in them useless; competition among supply dealers had ceased; a few received orders at their own terms; the quality of the goods purchased suffered



PURCHASING DEPARTMENT

STEPHEN W. McGRATH
PURCHASING AGENT

CITY OF CINCINNATI

Requisition_____

Cincinnati, O._____

Requisition for the following list of material has been made on this department for department as mentioned below and for delivery to destination as mentioned.

Prices to be submitted on or before_____

QUANTITY	MATERIAL, SUPPLIES, ETC.		

Request for price sent_____to

Order Mailed_____to

_____No.
_____No.
_____No.
_____No.
_____No.

PLATE II. *This bears a full description of the supplies upon which bids are to be received. It is posted on a bulletin board in the purchasing department under the day upon which bids will be opened for this class of goods.*

wide fluctuations; standardized articles were unheard of; thirty different departments would requisition thirty different kinds of paste, pencils, and pens. Conditions were chaotic.

The department had to be created anew. A successful business man, a manufacturer who had just retired, was chosen to undertake the task. That Mr. Stephen McGrath has given to the city of Cincinnati an efficient purchasing department, one based upon the best business principles, is evidenced by several pronounced facts. This department during the past year has saved the city a trifle over 10 per cent. on purchases aggregating three-quarters of a milllon dollars, the expense of conducting this department has been 2 per cent. of the gross purchases; and most convincing of all, the system is so simple and easily expanded that like all such methods which result in high efficiency it seems strange that it has not long since been inaugurated by this city and others over the country. There is no reason why its basic principles should not serve as a model for many hundreds of American cities seeking up-to-date methods of purchasing.

Enlisting the experience of the larger private corporations, Mr. McGrath, with the aid of a vast amount of data and suggestions from the Bureau of Municipal

Research through its accounting director, F. R. Leach, outlined and put the plan in operation.

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¶ A TRIPLE *check on the requisition prevents errors and collusion and gives the purchasing agent full authority to buy.*

Requisitions for supplies as needed by the various departments are made on forms, Plate 1, supplies of which are in each department. This form is the standard used in requisitioning the purchasing agent for all supplies. Before this order can be considered it must in all cases bear the signature of the store keeper, who declares the need of such supply; the department superintendent which shows his approval; and finally the director, or mayor if need be, who authorizes its fulfillment. It then becomes full authority for the purchasing agent's action. A copy known as the "Requisitioner's Copy" is made in carbon at the same time on a yellow sheet and retained by the storekeeper and bears his number. The purchasing agent's copy is then dated and given a serial requsition number. This number, which is absolutely independent of the requisitioner's number, becomes the means of identification of this purchase in the agent's office and is controlled and indexed by means of a card index which will be described later.

The requisition then goes to the standardization clerk, Edwin Waller, whose work has done much to place this department upon an efficiency footing. He checks the correctness of the order, determines whether or not the supply needed is properly described, that it conforms to a standard, if one has been set for this article, sees that it is of the most suitable quality and in the units necessary. He also recommends the most advantageous method of purchase and gives his opinion of the market conditions.

It is then ready for the order clerk, who copies on the form shown in Plate II a description of the supplies. This then goes to the bulletin board, where the merchants and vendors are advised of purchases to be made. Certain days have been set aside for the purchase of certain articles and only upon these days will such supplies be bought. This plan of definiteness as to purchases has resulted in concentration at all times on the article to be secured and is a great convenience to bidders, as it makes their presence necessary but once a week. Notices of purchases are posted sufficiently ahead of the day of buying so that advantage may be taken of as much competition as possible. Nothing is purchased without this public announcement, except goods which have been covered by contract agreement, which agreements have been entered into in the same public manner as already outlined.

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¶ EVERY *effort is being made to furnish vendors with adequate information upon articles for which bids are asked.*

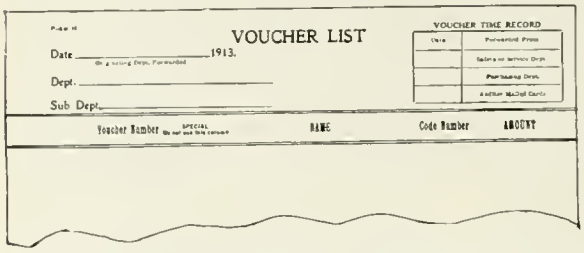
Below the bulletin board are cases containing samples, in so far as practical, of many articles which are standard with the city. Thus a contractor can often make a careful examination of the exact article needed and thereby bid with the greatest degree of intelligence.

In cases where unusual or important purchases are to be made post cards are sent to prospective bidders announcing that the city is in the market for certain supplies.

The bidder specifies his bid on a sheet, Plate IV, provided by the department, and files it in a sealed envelope, addressed to the purchasing agent, in a locked box in the agent's office. Upon the day and at the time specified the bids are then publicly opened and read in the presence of the interested bidders. Bids are carefully computed, and compared with the prices of similar articles purchased in the past. These records of past purchases are the most valuable assets in the purchasing agent's office. They will be described later.

The lowest bidder having been determined, the order is then made out in quintuplicate by means of typewritten carbons on tinted sheets each of a differ-

ent color and duplicates in every respect. All receive the signature of the purchasing agent, which shows that the order has come to him properly endorsed. The general form of these five sheets is exhibited in Plate V. Two copies are for the city auditor, one for the purchasing department and one for the requisitioner and one for the successful bidder.


VOUCHER LIST

VOUCHER TIME RECORD

Date _____ 1913.

Dept. _____

Sub Dept. _____

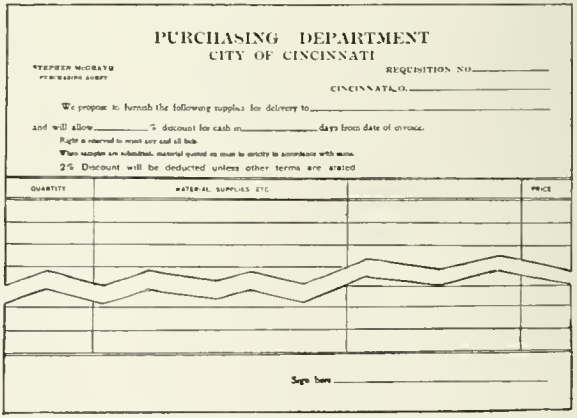
Voucher Number | NAME | Code Number | AMOUNT

PLATE III. *When all papers relative to an order are filed in the purchaser's office, a record of the passing of bills for vouchering to the city auditor is kept on this form.*

The auditor investigates the fund from which payment is to be made and debits this fund with the amount of the order. Thus payment is guaranteed and payment more than once prevented. This also serves as a check on the purchases of each department, preventing the incurring of liabilities beyond the amount appropriated. After the auditor has encumbered the funds of the department in question, the white sheet or "Auditor's Record" is returned to a file in the purchasing agent's office, which is known as the inspector's file. This file is divided into as many parts as there are departments for which supplies are purchased, each compartment being horizontal and approximately an inch and a half in depth and of a size capable of receiving all sheets flat. One side is specified as "open" and the other as "closed." The auditor's copy remains in the open side of the file until the goods have been delivered to the department ordering them.

Each day the three purchasing department inspectors receive from the departments assigned to them post cards similar to that shown in Plate VI advising them that certain supplies have been received. The inspectors then examine the articles and either reject or approve them as to quality, quantity and specifications on which they have been purchased. When the articles finally fulfill the inspector's demands he so certifies on the auditor's record and this record is then placed in the "closed" pigeon hole and the transaction is complete to the point of invoicing for the auditor. At the close of each day the three inspectors make full reports of the materials inspected by them on loose leaf sheets which are bound in a loose leaf binder. This report is made on a sheet seven inches wide, which is divided into seven spaces, these spaces being headed as follows: date of order, order number, requisition number, department, supplies or materials inspected, vendor, remarks. A single line is used for each order. This report serves as a complete record of each day's work of each inspector and shows the condition the goods as delivered to the requisitioning department.

The invoice clerk in the purchasing department attaches the vendor's invoice to the now completed auditor's record,


PURCHASING DEPARTMENT

CITY OF CINCINNATI

STEPHEN McGRATH
PURCHASING AGENT

REQUISITION NO. _____

CINCINNATI, O. _____

We propose to furnish the following supplies for delivery to _____

and will allow _____ % discount for cash in _____ days from date of invoice.

Right is reserved to reject any and all bids.

When samples are submitted, material quoted on must be strictly in accordance with same.

2% Discount will be deducted unless other terms are stated

QUANTITY	MATERIAL, SUPPLIES, ETC.		PRICE

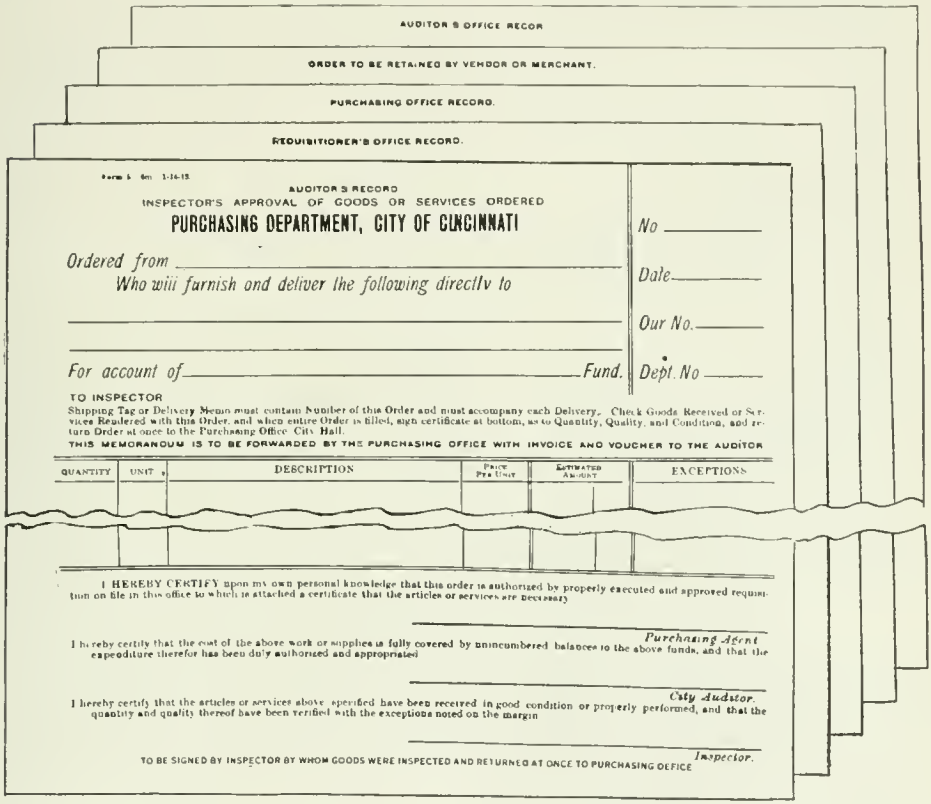
Sign here _____

PLATE IV. *All bids are submitted by the bidder on this form.*

which shows that the transaction has been completed in every manner and that the auditor has full authority to make payment for goods, which have been delivered in exact accordance with the demands of the department issuing the requisition and with the standards and terms set by the purchasing department.

A transaction has now been effected in which all concerned are fully aware of every detail. It has been so accomplished that there can be no opportunity for collusion, no misunderstanding and little possibility for errors. The purchase is scrutinized from every point. The need has been definitely established, the supplies have been made to conform to certain standards of quality, they have been purchased in open competition, have been bought with funds actually available, and have passed a rigid inspection.

The work of this department and that of regimes to follow has been greatly enhanced in value by a system of recording and filing of all information regarding past purchases.


AUDITOR'S OFFICE RECOR

ORDER TO BE RETAINED BY VENDOR OR MERCHANT.

PURCHASING OFFICE RECORD.

REQUISITIONER'S OFFICE RECORD.

Form 5 6m 1-16-13.

AUDITOR'S RECORD

INSPECTOR'S APPROVAL OF GOODS OR SERVICES ORDERED

PURCHASING DEPARTMENT, CITY OF CINCINNATI

No _____

Ordered from _____

Who will furnish and deliver the following directly to

Date _____

Our No. _____

For account of _____ Fund.

Dept. No _____

TO INSPECTOR

Shipping Tag or Delivery Memo must contain Number of this Order and must accompany each Delivery. Check Goods Received or Services Rendered with this Order, and when entire Order is filled, sign certificate at bottom, as to Quantity, Quality, and Condition, and return Order at once to the Purchasing Office City Hall.

THIS MEMORANDUM IS TO BE FORWARDED BY THE PURCHASING OFFICE WITH INVOICE AND VOUCHER TO THE AUDITOR

QUANTITY	UNIT	DESCRIPTION	PRICE PER UNIT	ESTIMATED AMOUNT	EXCEPTIONS

I HEREBY CERTIFY upon my own personal knowledge that this order is authorized by properly executed and approved requisition on file in this office to which is attached a certificate that the articles or services are necessary

_____ Purchasing Agent

I hereby certify that the cost of the above work or supplies is fully covered by unincumbered balances to the above funds, and that the expenditure therefor has been duly authorized and appropriated

_____ City Auditor.

I hereby certify that the articles or services above specified have been received in good condition or properly performed, and that the quantity and quality thereof have been verified with the exceptions noted on the margin

_____ Inspector.

TO BE SIGNED BY INSPECTOR BY WHOM GOODS WERE INSPECTED AND RETURNED AT ONCE TO PURCHASING OFFICE

PLATE V. *After the order has been placed carbon copies are sent to the various departments indicated at the top of each sheet. Each record is on a sheet of different color.*

On a card, Plate VII, is recorded complete information in regard to each commodity as it is purchased. The card as shown is self-explanatory. These are filed under commodity classifications. Thus when the water works department makes a requisition for valves of certain specifications it is a matter of but a moment's time to refer to this card index and determine all the facts in regard to past purchases of a similar ar-

Form 11-3. 1000

June 7 191 7

Sir:

Please take notice that the supplies described below were received on this date.

Respectfully,

Signature _____

Title _____

Dept. _____ Boro _____

Receiving Point And Location: Plum St yards.

General Description of Supplies: 17 Bales of Hay ✓ 71 Sacks of Oats ✓

Order No. 7070 7030

Name of Claimant: August Ferger & Co.

Contract (Yes or No) _____

Total Approximate Cost of this Delivery _____ OK.

For Inspection Department only.

RECEIVED 6/27/17 REFERRED _____

TO WHOM REFERRED Piggott.

PLATE VI. *A post card similar to this advises the inspector that goods have been received and await his inspection.*

ticle. At the time bids are opened the cards showing similar purchases are placed before the purchasing agent and he can at once compare the bids with those of the past, and determine whether or not it is advisable to accept the one before him, or call for bids again.

This record has also been valuable in determining the advisability of entering into continuing agreements. A full knowledge of the needs of any one department or departments for certain articles during the course of a year, enables the purchasing department to forecast the demand for a long period. As a result, when it is known that some thirty departments use in the course of a year a total of so many reams of letter paper, the agent saves the city large amounts by purchasing such supplies in quantities and entering into an agreement for the supplying of future needs at certain unit prices. Without such a card index a knowledge of the demand for anyone class of goods would be impossible.

As will be noted, this card bears the purchasing department order number. This number then makes it possible to refer to all correspondence, invoices, etc., which have entered into this particular transaction. All of these data are then filed in a 9-inch by 12-inch envelope bearing the purchasing department order number.

A warehouse has been established in the basement of the City Hall, in which a large supply of staple articles is constantly carried. The articles placed in stock are such as are in frequent demand by many departments, and which have hitherto been requistioned in small amounts. The net savings on such goods as are now placed in the warehouse and purchased in large quantities ranges from 20 to 35 per cent.

Aside from the purchase of supplies by a systematic method and in open competition, a large portion of the savings effected has been by means of standardization and the adoption of carefully drawn specifications which determine the quality in a very definite manner and leave little chance for a ven-

_____ DEPARTMENT Symbol No. _____

MATERIAL _____ Card _____

Date	Order No.	Req. No.	From whom purchased	Quantity purchased	Quantity delivered	Price	Amount of invoice	Date of inv.

PLATE VII. *Upon this card is recorded information in regard to each purchase. The cards are filed according to commodity classifications. This is the most important file in the agent's office, and the one about which the entire system revolves.*

dor to misunderstand just what it is necessary to supply. For instance where oil is purchased it must conform to certain tests as applied by the standardizing department, and coal is bought on the basis of the number of B. t. u.'s. An article well known by its trade mark has not the least preference over another not so well known in event the latter can be purchased at a lower price and in conformity with the specifications set for that particular commodity. The work of the standardizing department has resulted in the purchase of fewer kinds of articles and these bought in combination for all institutions and departments. By following this plan it is often possible to buy from manufacturers direct, thus obviating the payment of intermediate profits.

COST AND VALUE OF ROAD MATERIALS

The deputy state engineer of Minnesota, John H. Mullen, has made a comparison of the value and cost of roads of various materials suited to the conditions in his state, which shows the following results per mile of road:

Good Earth of Gumbo Roads.

Cost of transportation, 20 cents a ton mile.

Average first cost, $700.

Maintenance, $25 per year.

Total cost for 15 years, $1,075.

Suitable for light traffic on branch roads when proper system of maintenance is provided, but will not stand motor vehicle traffic.

Gravel Roads.

Cost of transportation, 15 cents per ton mile.

Average first cost including grading, $1,400.

Maintenance, $50 per year.

Total cost for 15 years with two resurfacings at $800 each, $3,000.

Suitable for heavy team and light motor vehicle traffic.

Macadam Roads.

Cost of transportation, 12 cents per ton mile.

Average first cost including grading, $4,000.

Maintenance, $50 a year.

Total cost for 15 years with one resurfacing at $1,200, $6,000.

Suitable for same traffic as gravel.

Concrete Roads.

Cost of transportation, 5 cents per ton mile.

Average first cost for single track roadway with gravel shoulders, including grading, $7,000.

Maintenance, $20 a year.

Total cost for 15 years, $10,000.

Suitable for all classes of traffic and especially for rapid or heavy motor vehicles and heavy team traffic. Will develop intensive dairy and truck farming and greatly increased traffic.

Where present or future traffic is continuous in both directions the pavement should be double track width, would cost $10,000 per mile and would have practically no maintenance charge in 15 years' wear.

Brick is equally good for such roads but under present conditions in Minnesota is prohibitive in price.

A bituminous wearing surface ⅜-inch thick, applied to the concrete, renders the pavement softer to traffic and removes the glare of the white concrete to some extent. It costs about 10 cents per square yard and must be renewed as it wears out with frequency depending largely on the amount of traffic.

SEWAGE PURIFICATION
at
ATLANTA, GA.

The results of tests conducted over a period of six months on the largest installation of Imhoff tanks in America show that this system has met with the expectations of the engineers. A review of the method of operation shows the principal difficulties encountered and the ways in which they were overcome.

ONE of the sewage purification plants at Atlanta, Ga., has now been in operation long enough to give some indication of its efficiency and character and its effect upon the surrounding country.

The city of Atlanta is built upon a rather broken area having three principal creeks which drain it. The distance to the Chattahoochie river, into which they all discharge, and the small dilution which they give to the sewage, require purification and it is more satisfactory to put a purification plant upon each creek than to attempt a combination of them all in one plant. Some five smaller areas in the city will have their sewage pumped into one or the other of the systems designed, when the construction has proceeded to the proper point according to the plans.

The first of the three purification plants to be completed is that for the Proctor Creek district, which has a rated capacity of 3,000,000 gallons a day. The experience gained in this plant may cause some changes in the details of other plants altho all three contracts for construction were let by March, 1911, and the Peachtree Creek plant, with capacity of 8,000,000 gallons a day, is nearly completed. The Intrenchment Creek plant is not so far advanced. Its capacity is 5,000,000 gallons a day.

Each plant will receive the sewage to be treated thru an intercepting sewer two to four miles long which takes the ordinary flow of sewage from the collecting sewer mains and carries it to its purification plant, leaving storm water to continue its way untreated down the creek to the river. Each intercepting sewer can carry an amount of mixed storm water and sewage which is three times the amount of sewage alone. The purification plants will take care of a flow of mixed storm water and sewage equal to double the flow of sewage alone. On the occasions when the flow thru the intercepting sewer exceeds double the sewage flow a by-pass takes the excess into the creek without passing thru the tanks.

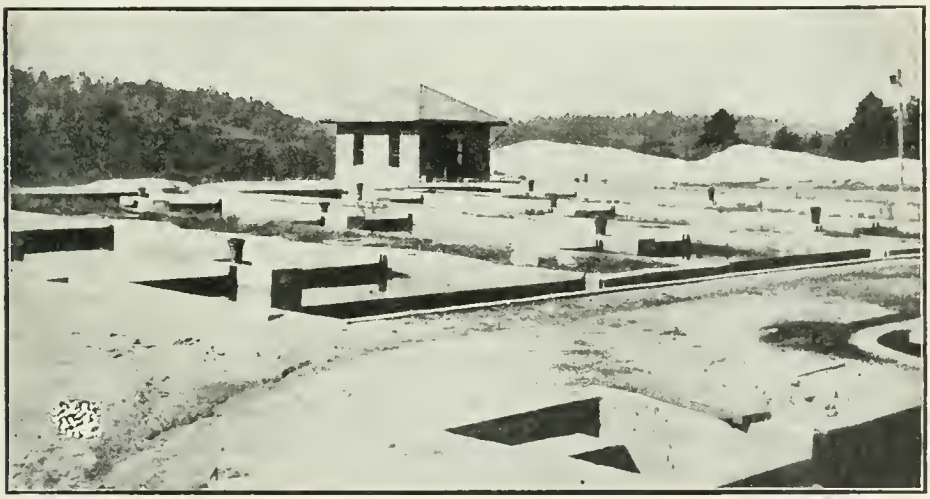
The Proctor Creek plant has been in operation for about one year and the accompanying tables of results, which are averages for each of the first six months of 1913, give a fair idea of the ability of the plant to purify the sewage. Some slight changes have been made in the

plant as the result of the experiments in beginning their operation, which are included in the following description.

The sewage in the Proctor Creek plant is somewhat more concentrated than is usual for, in addition to the sewage from the population for which it was designed, it is taking care of the night soil from some 20,000 to 30,000 additional population. This night soil is collected regularly from a section of the city which has no sewers and is dumped into the main sewer of the Proctor Creek district thru a special connection made for that purpose at the garbage disposal plant near the Railway Terminal station. It is thus thoroly mixed with the sewage and materially increases the organic matter contained in it.

Many streets in Atlanta are not paved and there is much coarse sand in the soil. A large amount of this sand finds its way thru the intercepter, especially after rain storms, and it was necessary to add a sand pit, thru which the sewage passes on its way to the grit chambers of the original plan. This sand pit can be flushed out, whereas the grit chambers must be emptied by hand, and the sand pit is therefore a great convenience at times. A coarse screen stops large floating matters which would clog the chambers or tanks.

The grit chamber is in three sections which can be used together, in pairs, singly, or by-passed entirely, according to the necessities. The drains at the bottoms of the sections are covered with coarse broken stone so that they will not be disturbed unintentionally when the collected sand is shoveled out. The grit chambers are emptied of sand about once in six days.



1. ATLANTA *Sewage Disposal Plant. Parts of sand trap and grit chamber show in lower right-hand corner. Imhoff tanks in center, with screen and head house at rear corner, distributing sewage to filters beyond on the left.*

A small part of the sand pit and the rounded corner of the by-pass of the grit chamber are seen in the right foreground of the first of the accompanying photographs.

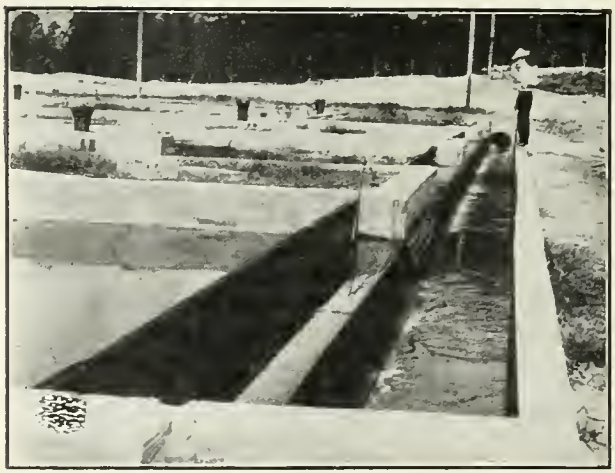
From the grit chamber the sewage flows into the inlet conduits which surround the area containing the twelve Imhoff or preliminary settling tanks on three sides, with one flowing across the middle of the area. From these inlet conduits the sewage can be fed to the four sets of tanks of three each from either end. Should the sewage be fed into one end only the first tank in the set would receive most of the sludge, and the middle tank nearly all the remainder, but by feeding the sewage alternately into each end the three tanks receive nearly equal amounts of sludge and all

three tanks of a set are thus ready for sludge discharge at the same time. This aids in securing uniform results. The flow is reversed about once in three weeks.

The sludge which settles from the sewage in the tanks slides down the inclined bottoms of the tanks and thru a long opening between these inclined bottom slopes into the sludge tank below. The water in the tanks is thus clarified and but little floating matter or growth of organic matter is seen in it, under ordinary circumstances. Flush and scum boards prevent such matter flowing out of the tanks, the clarified sewage flowing over the weirs into the outlet channel as shown in the second of the accompanying photographs, which also shows enough of the water in a tank behind a scum board to indicate the ordinary condition of the sewage in the tanks.

The sludge decomposes in the sludge tank under the inclined bottoms of the upper tank, which are so set that any gas which forms in the process passes up on the under side of the inclines and out thru the ventilating boxes which project up thru the centers of the tanks as shown in the first photograph; and also thru the lens shaped openings outside the tanks at the middle of each side, one of which is seen on the left edge of the first photograph.

The thick scum which forms on the surface of a septic tank is also in evidence in these sludge tanks and appears in the ventilating openings above described, becoming at times quite solid. A peculiar phenomenon has occurred several times in the Proctor Creek tanks, the reason for which has not been definitely determined as yet. The mass in a sludge tank suddenly begins to foam and run out thru the ventilating boxes; the peculiar, semi-liquid sludge boiling up over the sides of the boxes and running out over the ground or over the water in the upper tank. The third of the accompanying photographs shows the effect of this effervescence. The iron pipe, which is the top of the sludge discharge pipe, projects up thru the ventilating box and the sludge has foamed up around it, has run down over the concrete sides of the box and has spread over the surface of the water. It has been suggested that a high percentage of fat in the sewage may have something to do with this phenomenon, the fat in the sludge sometimes running as high as 11 per cent., as shown in the table of sludge analyses. This has not been demonstrated, however. Drawing off sludge from the pit below will stop the foaming, but no other method of stopping it and no method of preventing it has been devised.



II. CHANNEL *at rear of Imhoff tanks, serving to carry sewage to the tanks or by reversal, with stop planks to carry the effluent to the screen and head house, as here operating. The clear water in the settling tank is seen behind the scum board in the left foreground.*

The sludge is drawn off by means of a sludge pipe connected with the vertical sludge pipes of each sludge pit, shown in the photographs. This connection is below the level of the water in the tanks, so that the sludge is forced out by the head of water in the tanks. To prevent sticking of the sludge to the conical bot-

III. THE SLUDGE *in the digesting tank below has foamed up and over out of the openings from that tank to the air, and is spreading over the water in the upper tanks and over the ground. This action is stopped by drawing off the sludge from below.*

toms of the sludge tanks, a lead water pipe is run round each of them about 5 feet above the point of the cone, with one-eighth-inch holes. When water is let into this pipe it softens the sludge next to the concrete surface and permits it to slide down to the bottom. Here it flows into the bellmouth at the bottom of the sludge pipe and is forced up it and out into the discharge pipe. It is further aided by a stream of water from another lead water pipe which discharges upward into the bell mouth of the sludge pipe and both softens the sludge and aids in forcing it up to the discharge pipe. After the discharge of sludge fire hose is connected to the projecting tops of the sludge pipes and all the sludge in them is forced back until they are clear.

The sludge discharge pipe carries this partly liquified sludge to the sludge bed seen in the fourth photograph.

This bed is about 45 by 215 feet, is level, and has a bottom of broken stone covered with sand. The divisions seen in it are made with boards, set so that each discharge from a set of tanks will fill one section some 7 to 10 inches deep. The sludge is practically odorless, soon loses much of the 85 to 90 per cent. of water mixed with it and, if it does not rain, soon dries out enough to be handled. It is then only an inch or two thick, is scraped up by shovels and put into cars on the two little railways running over the bed, and can then be deposited anywhere it is needed. Thus far much of the sludge has been used in forming a soil for the grass which has been sown upon the new fills about the tanks and buildings. These fills are of sand so that there is plenty of use for the sludge for some time.

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A MOVABLE *roof for the sludge bed has been suggested.*

The end of each branch for discharging the sludge onto the sections of the bed is seen in each little concrete wall in the photograph of the bed, of which there are five on each side of the bed.

Where rains are frequent and evaporation is slow, a movable roof in sections has been suggested for the sludge bed. This roof can be run on rails and anchored to the supports so that it will

not be blown away, and it can be kept off the beds except when rain is actually falling. Where sludge drying area is limited and high priced, the roof may be found economical.

Sludge has been run into the low ground beyond the sludge and filter beds seen in the fourth photograph, where it drained and dried on the sandy soil, which was not specially prepared for it. This is done occasionally when convenient.

The prominent claim for the Imhoff tank is the innocuous nature of the sludge from it. The Proctor Creek plant furnishes a demonstration of the validity of this claim.

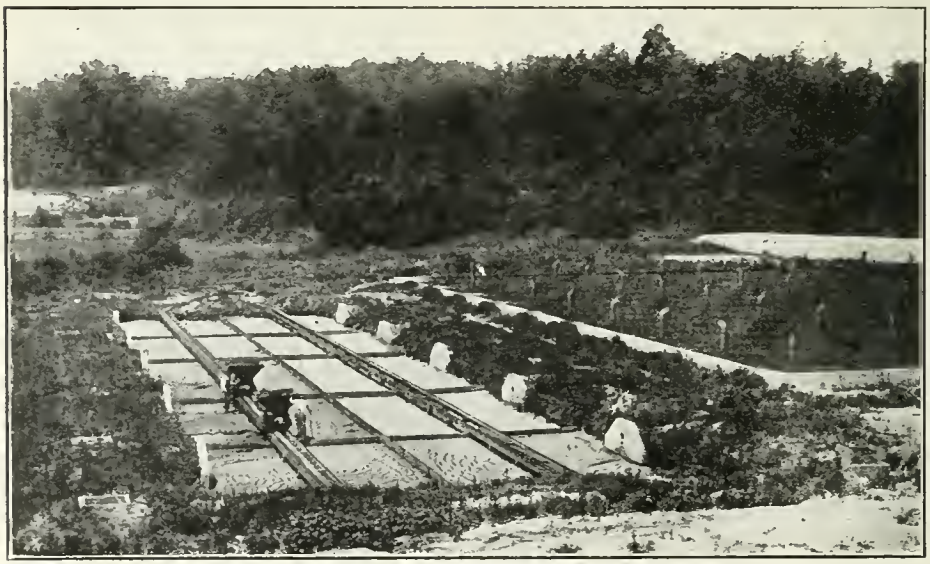
The clarified sewage which has passed thru the settling tanks flows to the gate house at one corner of the set of tanks, the location and size of which are shown in the first photograph. Here it passes thru a screen to remove any materials large enough to endanger clogging of the sprinklers by which the clarified sewage is distributed over the filter beds.

This screen is a revolving drum screen of the Weand type but at the stage of the purification process at which it is used, it is not necessary to revolve it, the amount of material to be caught by it being very small. A considerable part of the deposit on the screen seems to be greasy in its nature, forming a thin slimy film which sticks to the screen. There being no source of heat about the sewage disposal plant, it is very difficult to clean the screen of this film. The sewage is run thru the stationary screen, and there is little complaint of stoppage of the sprinkler heads of the filter bed.

The Peachtree and Intrenchment Creek plants were provided with roughing filters instead of revolving screen. Their efficiency is yet to be tested.

From the screen the sewage is discharged into the dosing tanks for automatic intermittent discharge to the two filter areas, one with an area of one acre and the other of one-half acre with space adjoining sufficient to increase it to one acre when demanded.

The sprinklers start under a head of 9 feet and the dosing tank is emptied at 2.5 feet head, and each discharge is counted automatically, so that the

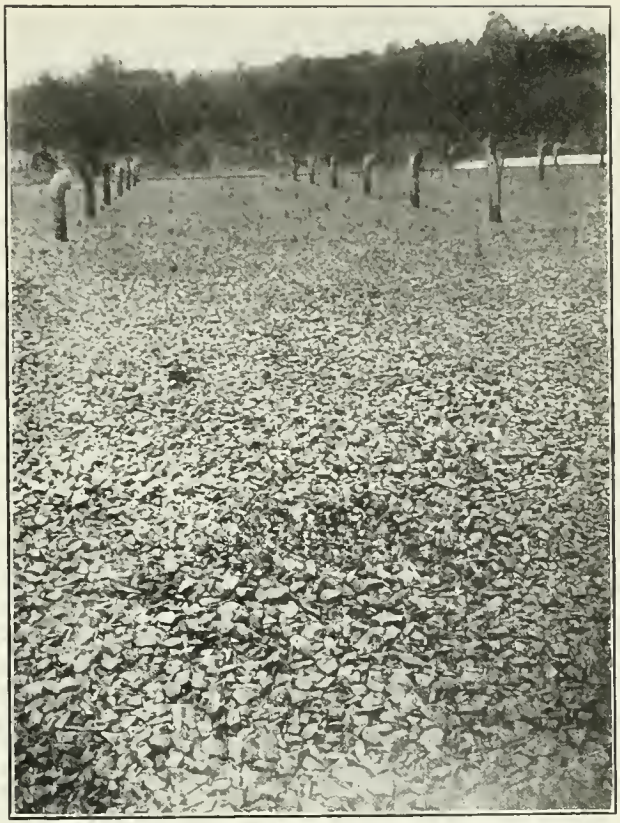


IV. SLUDGE BED, *The semi-liquid sludge is run by gravity from the Imhoff tanks thru the pipes whose ends are seen in the small concrete end walls, of which there are five on each side of the bed. Each discharge from one of these pipes is enough to fill one of the divisions of the bed 7 to 10 inches deep. After drying the sludge is shoveled into the little cars running on the railways over the bed.*

amount of sewage put thru the filters is known almost exactly.

The fifth photograph shows a closer view of the surface of the broken stone filter than can be seen in the fourth. The sprinkler heads can be seen projecting slightly above the stone, and the ventilators which run with the cowls moving with the wind are seen in the background.

When the sprinklers, of the Taylor type, are operated under full head, there is some overlapping of the sprays and recently some ponding of sewage upon the surface has been observed, occurring mainly where this overlapping occurs. This gathering of water does not indicate stoppage of the filter bed further than a small depth near the surface, for a very slight stirring of the surface stones causes the water to disappear.



V. THE SURFACE *of the contact filter bed filled with broken granite. The sprinkler heads which distribute the tank effluent over the surface of the filter are seen at the level of the surface of the bed. The ventilating pipes from the bottom of the bed, with their wind cowls, are the most prominent feature of the view.*

The valves on the service pipes to the sprinklers have been partly closed so as to reduce the maximum head on them and the overlapping areas are given a rest. The areas nearer the sprinkler head centers thus receive a greater supply. Before this results in ponding it is expected that the sluggish areas will have renewed themselves and be ready for full operation again. The throttling of the discharge causes slower discharge from the dosing tank and reduces the time between doses. This can be relieved somewhat by adjusting the levels of discharge in the dosing tanks. Altho a definite reason for the ponding has not been assigned, it is hoped that the occasional variation in pressure at the sprinkler heads and consequent change in spread of the sprays will keep the beds in good working order.

A chemist is in constant attendance upon the plant, makes frequent analyses of the sewage and the effluents, modifies the operation of the plant as required, and keeps daily records of the results of his work. The accompanying tables give the averages of these daily analyses for each of the first six months of the present year and show the efficiency of the plant since it has been in full permanent working order. We are indebted to W. A. Hansell, Jr., the assistant chief of construction of the city of Atlanta, for facilities and information furnished and to Charles C. Hommon, the chemist in charge for the tables of results of analyses.

RESULTS OF OPERATION OF SEWAGE DISPOSAL PLANT AT ATLANTA, GA.

Chemical Analyses of Sewage and Effluents from Settling Tanks and Filters—Monthly Averages of Daily Analyses—Parts per Million.

	Jan.	Feb.	1913. Mar.	Apr.	May.	June.
SEWAGE.						
Nitrogen as						
Organic	13.6	14.7	10.3	11.1	10.7	11.3
Free ammonia	18.3	19.5	16.6	16.8	17.8	21.1
Nitrites	0.1	0.1	0.1	....	....	....
Nitrates	2.1	2.5	3.0	2.6	2.3	1.6
Oxygen consumed	...	....	80.9	90.0	....	....
Suspended Matter.						
Total	303	213	219	269	280	267
Volatile	146	99	...	...	...	...
Fixed	157	112	...	...	...	...
Dissolved oxygen	4.3	4.6	3.8	1.9	2.1	1.6
EFFLUENT FROM IMHOFF TANKS.						
Nitrogen as						
Organic	12.5	11.5	7.0	6.5	7.4	6.7
Free ammonia	21.1	21.5	17.4	18.7	19.0	20.9
Nitrites	0.1	0.1	0.1	...	...	...
Nitrates	2.1	2.9	2.7	2.1	2.1	1.2
Oxygen consumed	...	...	61.6	59.1	...	...
Suspended Matter.						
Total	88	83	76	60	60	64
Volatile	48	41	...	...	...	...
Fixed	39	41	...	...	...	...
Dissolved oxygen	3.5	4.2	3.7	2.4	2.3	2.1
EFFLUENT FROM SPRINKLING FILTERS.						
Nitrogen as						
Organic	3.6	3.2	2.7	2.8	2.7	3.8
Free ammonia	12.2	14.4	8.3	6.3	7.0	8.5
Nitrites	0.8	0.6	0.5	...	...	...
Nitrates	6.7	7.5	9.5	9.5	8.8	7.9
Oxygen consumed	...	...	25.6	23.5	...	...
Suspended Matter.						
Total	59	54	68	41	34	51
Volatile	31	26	...	...	...	...
Fixed	28	28	...	...	...	...
Dissolved oxygen	8.1	7.3	7.1	6.3	5.4	4.5
Relative stability number	98	95	98	99	98	91
TEMPERATURES, DEGREES F.						
Sewage	61	60	63	66	70	74
Effluent from tanks	60	58	60	65	69	72
Effluent from filters	55	54	59	63	69	74

For January and February the numbers of bacteria per cubic centimeter of influent and effluents were counted, and determinations of volatile and fixed suspended matters were made, and for the first three months nitrites were also determined, but the value of these determinations not being equal to the trouble and expense of making them, they were discontinued. Following are the bacterial counts for January and February, 1913:

In sewage.	January.	February.
Total bacteria per c.c.	140,000	212,000
Red colonies per c.c.	208,000	60,000
In effluent from Imhoff tanks.		
Total bacteria	444,000	204,000
Red colonies	106,000	85,000
In effluent from filters.		
Total bacteria	212,000	143,000
Red colonies	21,000	47,000

At the beginning of the operation of the plant some analyses of the sludge were made, the results of which are given in the accompanying table, each line giving the result of a separate determination and the average being in each case the average of the number of determinations actually made. At present only occasional sludge analyses are made.

SLUDGE ANALYSIS—ATLANTA SEWAGE DISPOSAL PLANT.

Specific Grav.	Per cent Moisture	Per cent Vol.	Per cent Fixed	Per cent Nitrogen	Per cent Fat
	88.7	45.0	55.0	1.16	9.76
	88.3	33.3	66.7	1.26	6.92
	79.3	28.0	72.0		7.34
1.02	87.8	38.6	61.4	1.44	6.84
1.05	84.2	42.2	57.8	1.28	6.42
1.02	87.6	39.9	60.1	1.28	5.84
1.03	87.7	35.5	64.5	1.12	4.0
1.03	90.2	37.9	62.1	1.2	7.14
1.02	86.2	38.5	61.5	1.28	11.12
	86.3	39.7	60.3	1.28	10.0
1.0	87.7	42.5	57.5		
1.01	90.0	37.1	62.9		
1.0	87.0	45.0	55.0	1.28	8.5
	87.7	44.0	56.0		
1.02*	87.05	39.1	60.9	1.25	6.11

*Averages.

WHY SOME MUNICIPAL ASPHALT PLANTS FAIL

By H. B. PULLAR, Engineering Chemist,
Detroit, Mich.

A SPECIFIC *instance is described of why one municipal asphalt plant failed to prove a success. The conditions described may easily apply to others. Mr. Pullar, who is an expert in the handling of asphalt, points the way to efficient methods of management that will make such plants more successful.*

MANY cities throughout the United States and Canada now own and operate their paving plants. A majority of these paving plants have proven to be successes but a number have been unsuccessful. It is not the intention of this paper to discuss the advisability of municipal paving plant ownership, but to show in a manner why some municipal paving plants fail to accomplish their purpose and prove to be losing ventures for the cities that own them. As facts are more interesting than theory, a short description of the methods used by one city owning a municipal paving plant may prove interesting.

This city, of about 50,000 inhabitants, situated in the Middle East, purchased a municipal paving plant and the necessary equipment for laying their own pavements, the initial capital expense amounting to about $10,000. According to the usual custom, the plant manufacturers offered the services of a so-called expert to get the plant in running order and demonstrate its economical qualities. This so-called expert, as is too often the case, was not familiar with the paving industry, and was absolutely incapable of organizing and properly running a paving plant. The city engineer, whose paving experience had been largely that of supervising the laying of brick pavements, justly became disgusted with the methods of this so-called expert and decided to operate the paving plant according to his own ideas.

Without intending to criticize unjustly the engineer and other officials in charge of this municipal asphalt plant, for, without question, they were running it to the best of their ability, the operation of this plant under the conditions was one which was bound to result in a failure for the municipal plant and which eventually would disgust the taxpayers with municipal plant ownership.

The concrete foundation was laid according to the same grades and profiles used for laying brick pavements, and was in most places rough and uneven. The laying of the foundation to such grades naturally made it necessary to put down a bituminous pavement consisting of a binder and wearing surface of between 5½ and 7 inches, which, of course, was contrary to all correct and recognized principles of sheet asphalt construction. The engineer gave as his excuse for laying foundation in such a manner, that should the sheet asphalt prove a failure then it could be easily torn up and replaced by a brick pavement.

The paving plant was in charge of an old man who had had some previous experience in plant work, but who was not familiar with the present day methods and who was certainly not running the plant in an economical way. The plant site was too small and was care-

lessly laid out, making it impossible to run the plant efficiently.

On account of there not being any satisfactory stone in the near vicinity, gravel was used for binder. It was used just as it came from the pit and contained a considerable percentage of round, smooth boulders varying in size from ½ to 2 inches in diameter. Of course, it was absolutely impossible for the binding material to hold and bind these boulders together in any way. While this unsuitable gravel was run into the mixer from one side of the plant the asphalt cement was run into the mixer in chunks from the opposite side, the melting and mixing going on simultaneously. This is contrary to the best practice and much better results could have been accomplished at a very small expense by having a separate kettle for melting the asphalt cement. After the mix had been running for what the foreman considered a satisfactory period it was dumped into wagons. By the time the last of the mix was out of the mixer the temperature was about 50 degrees higher than the first that came out, the result being that there was usally a part of the load that was either too cold or overheated.

The binder was then taken to the street and laid by an inexperienced crew (as will later be described) to a thickness of between 3 and 4 inches. After there had been laid what was considered a sufficient amount of binder, the plant was stopped and changes were made in order to run the surface mixture. No system was used in making these changes from running binder to surface mixture and there were many useless and expensive delays.

The surface mixture consisted of sand, marble dust and asphalt cement, the sand and marble dust analysing as follows:

Sand.

	Per Cent.
Passing mesh 200	0.0
Passing mesh 100	0.0
Passing mesh 80	0.5
Passing mesh 50	12.5
Passing mesh 40	14.0
Passing mesh 30	28.0
Passing mesh 20	13.5
Passing mesh 10	13.5
Passing mesh 4	20.0

Marble Dust.

	Per Cent.
Passing mesh 200	80.6
Passing mesh 100	12.4
Passing mesh 80	6.0
Passing mesh 50	1.0

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¶ WEARING *surface improperly mixed, handled, and haphazardly rolled.*

The marble dust was of good quality and satisfactory for filler. The sand, which was to comprise 80 per cent. of the pavement, and which is too often considered of little importance, was very poor and unsatisfactory for high grade sheet asphalt work. As will be noted by the grading it was entirely too coarse and especially so when the heavy traffic of the street was taken into consideration. Sometimes it is necessary to make the best possible mix out of the available materials, but in this instance a suitable sand could have been obtained at a very small increase in cost. This poor quality of sand mixed with too low a per cent. of marble dust was run into the mixer at the same time as asphalt cement and, as was the case with the binder, all the materials were heated and mixed simultaneously. After the mixture had been heated for what was considered a satisfactory length of time it was dumped into wagons, the same deviation of temperature occurring during the discharge. The wearing surface after having received this improper treatment at the plant was taken to the street and carelessly laid and rolled to a thickness of between 2½ and 3½ inches.

The inefficiency exhibited by the street crew was even worse than at the plant. This crew did not contain a single man who was experienced in the laying of sheet asphalt pavements. The rakers, tampers and smoothers were merely laborers picked up in the city and knew nothing whatever about paving construction. The rollerman was inexperienced in paving work. He knew nothing at all about proper compression or the proper time to start rolling the hot material, and he considered the pavement sufficiently rolled when it looked fairly smooth. Even a

good rollerman would have had difficulty in rolling and getting the proper surface and compression to a bituminous pavement of this thickness.

Two samples taken from the pavement laid under these conditions analyzed as follows:

Sample 1.

	Per Cent.
Bitumen	8.62
Passing mesh 200	4.1
Passing mesh 100	1.4
Passing mesh 80	1.5
Passing mesh 50	14.0
Passing mesh 40	29.4
Passing mesh 30	14.6
Passing mesh 20	12.3
Passing mesh 10	10.0
Passing mesh 4	12.7

Sample 2.

	Per Cent.
Bitumen	7.4
Passing mesh 200	5.0
Passing mesh 100	2.0
Passing mesh 80	1.0
Passing mesh 50	14.4
Passing mesh 40	27.0
Passing mesh 30	10.6
Passing mesh 20	11.2
Passing mesh 10	9.8
Passing mesh 4	19.0

It might also be interesting to note that this pavement was being laid on one of the heavy traffic streets of the city and also on a street containing car tracks.

Just before the paving season closed this condition of affairs was brought to the attention of the city officials in charge and after some considerable discussion in which there was an attempted defense of the methods used, it was decided to allow an experiment to be made in laying a strip of pavement under better conditions.

¶ METHODS *used to place the plant and construction work on a more efficient basis.*

The first thing that was done was to put the work under the supervision of an experienced man thoroly familiar with the proper laying of sheet asphalt pavements. He secured a few experienced men from a near-by city and carefully watched the rest of the men and instilled into them a little pride in the work which they were doing. On account of being very near to the end of the paving season and the fact that it would have delayed the work considerably to get in more suitable materials for the binder and wearing surface, he took the materials which were on hand and proceeded to get the best results with them. The first thing that was done was to obtain an inch screen and screen out all the big stones contained in the gravel which was used for binder. This cost amounted to about 30c per cu. yd. More dust was added to the mix to stiffen it up and the percentage of bitumen was increased to properly coat and bind the mineral aggregate. Careful attention was given to the details at the plant and on the street, temperatures were controlled as much as possible, and a fairly uniform mix was obtained. A sample taken from the pavement laid under these new but improved conditions analyzed as follows:

	Per Cent.
Bitumen	10.0
Passing mesh 200	6.4
Passing mesh 100	1.0
Passing mesh 80	2.3
Passing mesh 50	2.3
Passing mesh 40	14.0
Passing mesh 30	6.3
Passing mesh 20	8.7
Passing mesh 10	10.2
Passing mesh 4	14.3

The foundation was laid to a satisfactory grade so that the pavement consisted of 1½ inches of binder and 2 inches of wearing surface. The mix was taken from the plant to the street in covered wagons where it was handled by experienced rakers and the rollerman was made to continue rolling both lengthwise and diagonally until the surface was smooth, had the required compression, and was free of marks and imperfections. Under these very adverse conditions a saving of a little over 25c per square yard was made in the wearing surface and a little over 24½c per square yard in the binder, or a total of practically 50c per square yard saved on the bituminous part of the pavement alone. Besides this there was a considerable saving made on the foundation and on the grading, of which the details were not kept.

The following table gives a comparison of the amount of material and costs of con-

struction between the work which was laid under the poor conditions existing at the municipal plant and under the adverse but improved conditions of expert supervision:

Binder Mix.

	Weight of Mix per sq. yd.	Cost per sq. yd. complete
Old conditions	400 lbs.	$0.52
Expert supervision	188 lbs	.2718

Top Mix.

	Sand per sq yd., lbs.	Dust per sq. yd., lbs.	A. C. per sq. yd., lbs.	Mix per sq. yd., lbs.
Old conditions	250	26.3	39	315.5
Expert supervision	169	21.3	18.7	209

Old conditions, cost per sq. yd. complete	$ .75
Expert supervision, cost per sq. yd. complete	.4987

While the above example of inefficiency in running a municipal plant is, of course, unusual, and, in fact, ludicrous to those familiar with the industry, it is an accurate account of the exact condition existing in this particular city. If this poorly managed department had continued to operate the plant with its inefficient organization, tax payers would be amply justified in condemning municipal plant ownership.

¶ PAVING *plants properly operated are an asset to a city, but many of them can be more economically managed than at present.*

While the above example is one instance where a municipal plant will eventually become an absolute failure, there are many other municipal plants throughout the country that are not proving to be good investments to the cities and are not being run to their maximum efficiency. There are many ways that savings could be accomplished and if these plants were put under efficient management of somebody well versed in the paving business they would be very valuable assets for the city. For instance, a municipal plant in one of the Western cities saved over $1.00 per car on every carload of sand that came into the plant by merely rearranging the material and storage space and putting in about 50 feet extension on the side track. There are many details connected with paving plants by which much money can be uselessly expended. Cramped quarters and insufficient storage room for crude materials are an expensive handicap and cities desiring to install municipal plants should be careful to give proper consideration to the location.

The most common form of municipal plant failure is the one well recognized by those connected with the industry, i. e., where the city appropriates and expends sufficient money for plant and equipment to take care of all its paving and then on account of the laws or on account of the policy of the administration can only run it a small part of each year for repair work. It is a waste of money for a city to invest in a plant having a capacity of from 1,000 to 2,000 yards of completed pavement per day and have only say 10,000 yards of repair work to be done during the entire season, and yet there are many cities owning their municipal asphalt plants where this condition prevails. In the writer's opinion no city should contemplate putting in a large municipal plant unless it expects to use that plant for at least 50,000 square yards per year. The maintenance and cost of operation for large plants are too great and the result is usually a failure. There are numerous small mixers on the market today which are satisfactory for cities who wish to do their own work amounting to only a few thousand yards per year. The initial and operating costs are small and when not in use they require practically no expense. The maintenance and depreciation are also very low.

There are many other causes for municipal paving plant failures which require long explanations, but it is at least encouraging to note that the cities owning municipal paving plants are waking up to the fact that sometimes failure can be turned into success and are putting their municipal plants under proper conditions to do the work for which they were intended.

HOUSTON'S PLAN OF TAXATION

By J. J. PASTORIZA,
Commissioner of Finance and Taxation,
Houston, Texas.

A PLAN of taxation which puts the burden on the land, the permanent improvements and the physical appurtenances of public service corporations, according to the area they occupy. It relieves cash and personal property. It is reported to be satisfactory to 98 per cent. of the taxpayers. It would not be so satisfactory if it was not accompanied by the Somers system of determining land valuations.

NINETY-EIGHT per cent. of the taxpayers of Houston are satisfied with, not only the Somers system, which we installed in the beginning of 1912 and which was continued for the assessment of 1913, but they are satisfied with the Houston, Tex., plan of taxation, which is an addition to the Somers system.

The Somers system is nothing more or less than a system of equalization of realty values. Under the Somers system property owners in a city indicate what they believe is the true value of a lot 50 by 100 feet in the middle each of the four sides of a block. This is mathematically reduced by dividing the sum by fifty and getting the price of one foot of land facing on the block running back 100 feet. This price is placed upon the map of the city. When this is done by the city assessor and the property owners themselves, the map is turned over to the representative of the Somers system, and by that system he calculates the value of all of the other lots in the block. This calculation insures to the owners of every other lot in the block a valuation which will result in a fair equalization of the commercial value of every lot in that block. The corner lots will be valued in proportion to the value of the property on the two adjoining streets. This system has been worked out by Mr. Somers, of New York, by taking thousands of cases of actual bona fide sales and getting at the averages.

The city of Houston, after applying the Somers system and getting the full sale value of every lot in the city and the full value of the cost of reproducing every building in the city, less depreciation occasioned by age or utility, then decided to adopt what has been since known thruout the United States as the "Houston Plan of Taxation." The Houston plan of taxation has no connection whatever with the Somers system, except that it uses the Somers system as a basis for the equalization of values of both land and buildings. The Houston plan of taxation, in a word, is as follows:

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¶ A BRIEF *summary of the fundamental principles of taxing land and franchises.*

Land to be assessed at its full value as ascertained by the Somers system; buildings or any other improvements, including machinery of manufactories, upon land, to be assessed for taxation at 25 per cent. of their reproductive cost, less depreciation. Franchises of all public service corporations to be assessed at a price which would be represented by the

value of that portion of the streets or sidewalks which are used by these public service corporations, either for the laying of tracks, the planting beneath the earth's surface of conduits, sewer or gas mains, or the installing upon the edge of sidewalks of telephone or telegraph poles.

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¶ CASH *and personal property, including household effects are not taxed. In two years assessments have increased* $33,000,000.

The Houston plan of taxation contemplates and provides for the total exemption from taxation of all cash owned by individuals or corporations deposited in the banks of Houston. In other words, there is not a dollar deposited in any bank in Houston which is taxed by the city. We have further exempted from taxation such personal property as is owned by the individual taxpayers, even including their household furniture and effects.

Notwithstanding all of these exemptions and the assessment of improvements upon land at only 25 per cent. of their cost, we find that the assessment rolls of the city show an increase in two years of $33,000,000, and the tax rate is reduced from $1.70 to $1.50 per $100 valuation. And that is not all. Owing to the equalization of values brought about by the adoption of the Somers system, we find that over 5,000 taxpayers have had their taxes reduced for the year 1912, when compared to what they paid in 1911, previous to the adoption of the Somers system.

You ask for our impression concerning this system and its practical workings. In reply I wish to state that after two years' trial I find that the plan of taxation having been approved by the previous administration and having been endorsed by this administration is satisfactory to over 98 per cent. of the taxpayers. The reason why it is so satisfactory is that the taxpayers realize that, no matter how powerful or influential a property holder may be, he cannot get his real estate assessed at a less value than his neighbors, because this office has shown the taxpayer how to calculate the value according to the Somers system and he himself can discover whether there has been any favoritism shown or not.

The property owner whose taxes have been increased is satisfied, because he does not in the future have to worry as to whether his neighbor or competitor is getting his property in for taxation at a less per cent. than he is.

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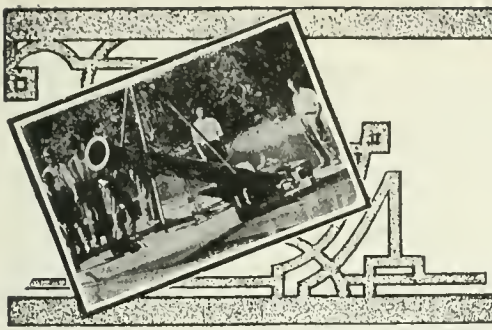
¶ THE SYSTEM *has apparently been permanently established, and can only be changed by a referendum vote of the taxpayers.*

This plan was adopted by the former administration upon my recommendation, and the present administration has also approved of it, so that it appears to the writer that the system has been established permanently, to be changed only by a referendum vote of the people themselves. We are adding to our charter a provision adopting the initiative, referendum and recall, which places within the hands of the people the right to change any law which the city council has seen fit to adopt. As far as the writer is concerned, while I may be wedded to the system, if a majority of the people should decide to change it, I would work under the change suggested by them.



EDITORIAL

FIRE PROTECTION.

Motor driven fire apparatus is a comparatively recent innovation and, until recently, it has not been possible to determine the true efficiency of this type of equipment. Reductions in fire losses due to the quicker and more efficient service resulting from motor driven installations have also been largely a matter of conjecture. The figures given in the article in this issue by H. W. Perry represent a thoroughly practical and reliable summary of results and the remarkable saving he records should serve to arouse the instant attention and interest of every city official. It is to be expected, also, that much additional information on the efficiency of motor driven fire fighting machines will be brought to light at the forthcoming convention of the International Association of Fire Engineers, to be held in New York City, September 1 to 6. Every city, large or small, should have one or more representatives at this convention.

EFFICIENT GOVERNMENT.

Many cities of the United States would gain much by turning their attention to Cincinnati. From a community ridden with bossism, known nationally as a city in the grasp of a powerful machine which collected its spoils unmolested for many years, it has emerged under the leadership of a fearless, fighting young lawyer to be one of the foremost examples of what it is possible to accomplish in the way of efficient government. Mayor Hunt has been in office for but two years. In that period he has put under headway a movement which by the very breadth of its principles will continue to gather momentum which a change in political temper will not be capable of stemming.

Efficiency has been his keynote from the day he stepped into office. He has gathered about him men who have been willing and enthusiastic to place their city on a higher plane. The inauguration of an "Efficiency Bureau" has been one of his big accomplishments. The men on this board have been untiring in their efforts. The Bureau has already co-operated

with the Street Cleaning Department, the City Hospital, the Waterworks Department and so forth and their records show that they have determined the exact cost of conducting their work. Today a foreman must get a standard amount of work from his gang or he is investigated.

The Purchasing Department, described elsewhere in this number, has been made a valuable asset in the city management and is saving it many thousands of dollars.

The influence of such a regime is evident on all sides. Passing thru various departments of the City Hall one is much impressed with the snappy, vigorous manner with which each clerk and executive is conducting his every day work. Quite a contrast to the sleepy, let-it-go-until-tomorrow atmosphere of many City Halls.

Results have been accomplished in Cincinnati in but two years. In order that this efficient mayor can continue to pull his city up the grade of reform he must now roll up his sleeves and fight for his re-election. The term is too short for a capable executive. Therein lies one of the great weaknesses of many American cities. Longer terms, protected by the recall, would insure cities as fortunate as Cincinnati a continuance of efficient government.

THE CITY AS A BUSINESS PROPOSITION.

The Dayton, Ohio, charter, an abstract of which is given on another page, is the latest well-considered and detailed effort to apply business principles and home-rule to city affairs. It treats the city as a business corporation, with the addition of the checks necessary because the business success cannot be measured by the profits. A good form of government does not insure good government unless the people demand it, but makes that result easier. Dayton's progress will be watched with the utmost interest by all advocates of economy and efficiency in public business.

CLEARANCE BETWEEN CAR TRACKS.

We still hear of serious accidents and deaths resulting from pedestrians being caught between two passing street cars. Usually such accidents occur in cities where no uniform practice as to clearance has been adopted, where, on some streets a person can easily stand unmolested between passing cars, and on others would be crushed to death. Every city should require that the clearance on all streets be the same—preferably so slight that no one would be tempted to run the risk of standing between cars.

QUESTION DEPARTMENT

Records for the City Engineer's Office

I understand that you have published articles on city engineer's office records. I am working up a system of records and would like to gather some data on how it is done.

B., City Engineer, ———, Ind.

A general list of the articles in MUNICIPAL ENGINEERING on the subject will be found in vol. xlii, p. 253. Those of most direct practical application are probably the following:

A review of the annual report of the city engineer of Salt Lake City for 1908, in vol. xxxviii, p. 56, gives an outline of the classification of accounts and records. The report, including the full schedule co-ordinating all the departments in the city engineer's office, can probably be obtained from the present incumbent. This is the most practical system of records which has been described in much detail in a printed report. Some of the forms of the loose leaf system used in the departments are reproduced in vol. xxx, p. 409.

A general description of a method of filing and indexing city engineer's records is given in vol. xxx, p. 270, based on the system in use in the office of the city engineer of Indianapolis, which has never been described in detail and is not so elaborate as that in use in Salt Lake City, tho thoroly practical.

Some special forms are given in articles or "Form of Grade Book for Small City," vol. xl, p. 210, giving a description of the form used; on "Record of City Improvements," vol. xl, p. 222, giving a reproduction of the blank used and an entry thereon; "Handling Day Labor in Holyoke, Mass.," vol. xxxviii, p. 202, reproducing a blank properly filled; on "Forms for Daily Force and Material Reports," vol. xxxviii, p. 270, reproducing the form and giving some criticisms of its contents; "Control of Workmanship on Asphalt Pavements," vol. xxxvii, p. 301, giving the forms of reports to the asphalt pavement inspector and chemist to enable him to know what is being done; on "A Daily Report Form for Street Work," vol. xxxiv, p. 239, for use when the work is done on day labor account for the city. All but three of these are for use on day labor jobs.

How to Separate the Fiber from Vegetable Tissue

I want to decompose some soft vegetable tissue or plant growth to obtain a fiber out of the plant, and want to find a cheap chemical to do this in a cold solution or in a hot one with several hours' boiling if need be. I have an idea that some method similar to that used in the manufacture of wood pulp would answer in my case. Can you tell me where to get full information about making up wood pulp, what chemicals are used, how to cook the pulp and under what pressure? I might use some of the same machinery.

B., ———, Fla.

There are several processes of treating wood pulp, which may be roughly classed as the sulphite, alkali and sulphate processes. Descriptions of them will be found in such books as Beveridge's "Papermaker's Pocketbook," ($4); Watt's "Paper-Making" ($3); Clapperton's "Paper-Making" ($2.50); Cross and Bevan's "Text Book on Paper Making" ($5). Good general descriptions will be found also in the large encyclopedias of recent publication.

Manufacturers of machinery for use in the various processes are Dilts Machine Works, Fulton, N. Y.; Olin Scott, Bennington, Vt.; Werner & Pfleiderer, Saginaw, Mich.; Waterville Iron Works, Waterville, Me., and many others.

Each vegetable fiber requires a process of its own, differing in detail or possibly as a whole from any other and there are many patents on machinery for dry and wet mechanical separation of fibers, for treatment by alkaline, electrolytic, acid and other methods. A new fiber would

require special study and experiment by an expert to determine with the least expenditure of money whether it could be treated and what process would be best, and the details must be worked out experimentally. The following description derived from the claims in patent 1,001,284, issued to Kreissl and Seibert of Vienna, shows some of the variations which may be made in a process in order to produce the best results:

"The process for obtaining textile fibers from vegetable material, such as nettles, hops, sunflower stalks and the like, which consists in softening and externally purifying the material by a preliminary boiling, then treating the material in an autoclave boiler with a diluted soda lye of 2 to 8 per cent. strength for about 5 minutes under a pressure of about 15 atmospheres, whereby the ligneous parts of the stems are completely destroyed, and then apply jets of water under pressure to the mass, whereby the fibrous material is obtained without requiring a mechanical removal of the bast, boiling the fibrous material again in a soda lye having a strength of about 8 per cent. for 3 minutes under a pressure of 10 atmospheres, again applying jets of water to the mass, placing the fibrous material in a bleaching solution, then immersing the fibrous material for a short time in a very diluted sulphuric acid, washing and drying the fibers and then treating the fibers with vapors of glycerin for a short time, whereby they are rendered flexible and smooth. The above process may be preceded by 24 hours treatment in cold lye water. The bleaching solution may be a solution of common salt subjected to electrolysis. The dilution of sulfuric acid, is 1 kilogram of acid to 100 liters of water."

Any of the bi-monthly volumes of the *Patent Office Gazette* contain descriptions of newly patented processes and machinery for treating and separating vegeable fibers for further use.

The advice of a chemist expert in the treatment of fibers will save much time, trouble and expense.

Pumping Equipment of Municipal Water Purification Plant, Grand Rapids, Mich.

Do I understand that entire pumping equipment of Grand Rapids, Mich., water purification plant, as described in your issue of June, 1913, was furnished by the Fort Wayne Electric Works, Fort Wayne, Indiana? I would also appreciate descriptive items with rated capacity and expenditures.

E. D. STRAUDHAUSSEN,
New Orleans, La.

In April, 1910, the city of Grand Rapids by vote authorized a bond issue of $400,000 to pay for the new water works project, and of this amount, $350,000 was to be used for the filtration plant proper and $50,000 for conduits and some additional machinery to be installed in the high-lift pumping station. The work of constructing the filtration plant was divided into four separate contracts.

Contract for the furnishing and installing of all pumping machinery on above plant was awarded to the Fort Wayne Electric Works, Ft. Wayne, Ind.

Under Item No. 1 were furnished three pumps, rated 5,600 gallons per minute with 26-foot head, 690 r.p.m., efficiency 68 per cent., 15-inch discharge, 15 to 18-inch suction, net weight complete with bearings, shafting, etc., 4,800 pounds. These pumps are direct coupled to Fort Wayne M-10-60-720, form RX, 440-v., 2-phase, vertical induction motors. These pumps are also rated 4,000 gallons per minute, 30-foot head, 64 per cent. efficiency; and 7,500 gallons per minute, 15-foot head, 48 per cent. efficiency.

Under item No. 2 were furnished two pumps rated 2,900 gallons per minute, 26-foot head, 850 r.p.m., efficiency 66 per cent., 10-inch discharge, 10 to 12-inch suction, net weight of pump with accessories, 2,600 pounds. These pumps are direct connected to Fort Wayne M-8-30-900, form RX, 440-v., 2-phase, vertical motors. Pumps are also rated 2,100 gallons per minute, 30-foot head, 62 per cent. efficiency; and 3,900 gallons per minute, 15-foot head, 46 per cent. efficiency.

Under item No. 3 there were furnished two pumps rated 1,000 gallons per minute, 38-foot head, 850 r.p.m., efficiency 60 per cent., 6-inch discharge, 6 to 8-inch suction, net weight of pump and accessories, 1,500 pounds. These pumps are direct coupled to Fort Wayne M-8-20-900, form RX, 440-v., 2-phase, vertical induction motors. They are also rated 400 gallons per minute, 52-foot head, 42 per cent. efficiency; and 1,300 gallons per minute, 29-foot head, 52 per cent. efficiency.

Under item No. 4 was furnished a sump pump rated 180 gallons per minute, 15-foot head at 850 r.p.m., 40 per cent. efficiency, 3-inch discharge, 3 to 4-inch suction, net weight of pump and accessories, 950 pounds. This pump is coupled to a Fort Wayne MA-8-2-900, form C, 440-v., 2-phase, vertical induction motor. Motors under items 1 and 2 pump water from the Grand River and operate both continuously and intermittently. Pumps under item 3 pump clear well water intermittently. The sump pump under item 4 takes drainage water from a sump in pump pit and delivers it to drain. The casings of all pumps are heavy cast iron with feet cast on same.

The impellers for pumps under items 1 and 2 are cast iron, for items 3 and 4, bronze. All pumps are equipped with ball thrust bearings.

The annual expenditures on construction of pumping station and installation of machinery are as follows:

	1909-10	1910-11	1911-12	Total
Pumping engine, etc	$37,849.02	$27,102.01	$6,103.13	$71,054.16
Boilers and foundation	486.41	17,948.17	4,299.57	22,734.15
Crane and crane railway	.....	.....	3,765.02	3,765.02
Stokers	70.05	3,873.01	1,851.08	5,794.14
Brick stack	9,153.56	.....	.....	9,153.56
Underground flue	2,939.23	632.56	257.04	3,828.83
Ash tunnel	.....	1,541.79	261.76	1,803.55
Pumping station and shops	31,372.67	62,571.75	14,860.41	108,804.83
Boiler house	20.09	17,147.52	3,457.55	20,625.16
Temporary buildings	193.76	500.86	.....	694.62
Heater and purifier	.....	611.83	661.20	1,273.03
Steam header	.....	16,271.01	13,960.83	30,231.84
Generators and motors	.....	343.08	6,442.57	6,785.65
Shop machinery	.....	941.04	40.50	981.54
Shop heating and plumbing	.....	1,782.76	152.39	1,935.15
Station heating and plumbing	.....	1,483.76	933.24	2,417.00
Station floors	.....	15.42	3,566.15	3,581.57
Real estate	.....	4,000.00	.....	4,000.00
Sidewalks and pavement	.....	.....	1,208.50	1,208.50
Wiring, station and shops	.....	.....	1,231.74	1,231.74
Stables	.....	.....	3,906.87	3,906.87
Condenser, exhausts, etc	.....	.....	6,326.82	6,326.82
Totals	$82,084.79	$156,766.57	$73,286.37	$312,137.73

Wire-Cut-Lug Brick—Vitrified Sectional Sewers

I wish full information and prices on wire-cut-lug brick from reliable firms. Also some information on the subject of vitrified sectional sewers.

M. F., ———, Ill.

The wire-cut-lug-block has increased in popularity so rapidly that over half the brick sold in 1912 by the members of the National Paving Brick Manufacturers' Association were wire-cut-lug blocks, altho less than one-third of the members of the association are licensed to make the brick.

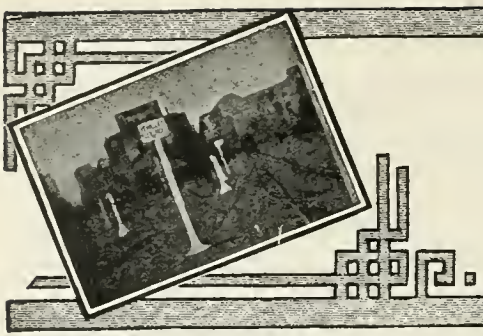
They are made now by about twenty of the leading paving brick manufacturers in New York, Pennsylvania, Ohio, Indiana and Illinois. The manufacturers in Illinois are the Danville Brick Co., Danville; Alton Brick Co., Alton; Murphysboro Paving Brick Co., Murphysboro. Those in Indiana are Clinton Paving Brick Co., Clinton; Wabash Clay Co., Veedersburg. These are all reliable firms who will give prices and full information. MUNICIPAL ENGINEERING is the best source of information about pavements built of the material and the number of the last year or so, since the block was put in the market, have had the latest information from month to month.

The vitrified sectional sewer is new but it seems to be good. It has been used successfully in some Indianapolis sewers built last year. The blocks are made by the American Sewer Pipe Co., Akron, Ohio. Lewis McNutt, Brazil, Ind., can also supply them.

Standard Specifications

You would oblige me greatly by letting me know where I could secure A. S. M. I. and S. P. S. standard specifications for different kinds of pavements. B., Montreal, Can.

Standard specifications of the Association for Standardizing Paving Specifications can be obtained from John B. Hittell, secretary, Street Department, Chicago, Ill., and will cost $5. The specifications of the American Society of Municipal Improvements are scattered through two or three of the annual volumes of the proceedings, but the secretary, A. P. Folwell, 50 Union Square, New York City, N. Y., can send separate copies of the specifications for asphalt, wood block and brick. The latest volume of proceedings, which costs one dollar, contains the specifications which have been adopted for concrete pavements, cement sidewalks, curb and gutter, and for sewers, which have not yet been adopted.



WORKERS IN THE FIELD

Fixed Carbon Not a Proper Test for Asphalts and Bituminous Road Binders

The Editor of MUNICIPAL ENGINEERING:

Sir—The question has often been asked by city and state engineers, as well as many producers of excellent asphalt and bituminous cements and road binders, what, if anything, has "fixed carbon test" to do with the quality of these products for pavement and road construction? The answer is that it has nothing to do with the qualities of these materials.

Fixed carbon is not a definite substance or quality in any given coal or other material. It constitutes the results of an arbitrary test of the approximate portion of coal which will remain and continue to burn and give heat after relatively light, volatile hydrocarbons have been partially burned away by flame. This test was devised solely for coal, by the committee on coal analysis of the American Chemical Society, and published in the *Journal* of the American Chemical Society, 1899, No. 21, p. 1116.

The test is made briefly as follows: One gram of coal is put on a "platinum crucible weighing twenty or thirty grams and having a tightly fitting cover. Heat over the full flame of a Bunsen burner for seven minutes. The crucible should be supported on a platinum triangle with the bottom 6 to 8 cm. above the top of the burner. The flame should be fully 20 cm. high when burning free, and the determination should be made in a place free from draughts. The upper surface of the cover should burn clear, but the under surface should remain covered with carbon."

It is therefore evident that the fixed carbon test has nothing to do with the quality or uses of asphalt, bitumens, asphalt cements and road binders. Burning and consequent destruction of the asphalt or bitumen proves nothing concerning the original condition and qualities before being burned. The qualities of the asphalt or other bitumens as used (not the burned products) are what are needed for cementing together and waterproofing the other materials in a pavement or road.

No two persons in the same or different places, with the various allowed sizes of crucibles, different sized Bunsen heaters, different kinds and pressures of gas, different lengths and sizes of flames, different distances the crucibles stand above the burner, even aside from the personal factor or difference in the way different persons work, can get the same quantity of fixed carbon (ash-free or otherwise) from the same sample of coal or other substance. When this variable process is applied to an asphalt or bituminous substance, even more widely varying and discordant results are obtained. It cannot be used as a basis of comparison of asphalt and bituminous materials, nor as a proof of their good or bad qualities.

The introduction of the fixed carbon test for coal into the asphalt industry has nothing to do with the determination of quality; nor can any minimum or maximum amount be set for this alleged test, between which all good asphalts and bitumens will come. Some good ones will be outside such limits, and some worthless asphalts and bitumens will be inside any limits attempted to be established by fixed carbon requirements. This test is sometimes used by chemists, simply as a small but imperfect indication, taken with other special chemical tests, to identify, if desired, an unknown or unnamed brand of asphalt, but has nothing to do with quality. This test should not be placed among the tests for quality of asphalt or any road building materials. The insertion of this test in any city, county, state or other specifications is purposely or unconsciously done, or caused to be done, by copying or otherwise from one or more persons or agents, who thereby seek to include some and exclude other brands of asphalts and road materials, which compete and are perfectly good for use.

The fixed carbon (coal) test should be

ignored, if still found in asphalt or bituminous specifications, and not enforced, not only on engineering, but also on legal grounds; that "the test does not apply to or establish any quality of the material necessary for the construction made or to be made;" i. e., in this case it does not apply to refined asphalt, asphalt or bituminous cement or road binder for constructing and waterproofing roads or pavements.

J. W. Howard, C. E.,
Consulting Engineer on Construction and Testing Roads, Streets and Pavements, New York City.

Concrete Pavement Costs

The Editor of Municipal Engineering:

Sir—With good equipment and an average gang the actual cost of mixing and placing should not exceed 7 cents per square yard for 7 inches of concrete. To this should be added a cost of 3 cents per square yard for finishing and labor necessary for handling the forms, making a total for one-course work of 10 cents for mixing and placing. As has been stated, there is a slight difference in the cost of placing single and two-course work, with the advantage in favor of the former.

Placing expansion joints is such a simple operation that 1 cent per square yard should cover the cost. To this must be added the cost of metal joint and tarred felt delivered on the job, or the cost of filling the joint with a plastic filler.

In discussing the cost of concrete pavements, a few examples of actual construction will help to make clear the division of expense. The first pavement was laid recently in a small town in the central part of Illinois, totalling 5,000 square yards. The total cost of the work was $3,964.02, excluding cost of equipment, which consisted of a ¾-yard Koehring mixer of the latest type and a 4½-h.p. gasoline engine, and also excluding the cost of the water for mixing and sprinkling. The pavement was 45 feet wide and uniformly 6 inches thick. The cost of the work was divided as follows:

Superintendence	140.00
1,457 barrels cement	1,547.15
Sand, stone and gravel	1,284.97
Labor	560.07
Lumber and forms	35.00
Bitumen and creosoted blocks for joints	48.67
Coal and oil for mixer and engine	30.75
Excavation	307.41

A summation of these figures gives the cost of this road as $4.76 per cubic yard or $0.79 per square yard.

In the west central part of Michigan 2,586 feet of concrete, 9 feet 2 inches wide and 0.55 of a foot thick, were constructed by a township as an experiment. A gang of twelve men using a 7-cubic foot side-delivery Koehring mixer did the work for a total cost of $3,392.62, divided approximately as follows:

746 barrels cement	$ 870.00
655.9 yards sand and gravel	553.28
Baker protection plates and filler	170.12
Labor	1,690.50

These figures give a cost of $7.28 per cubic yard or $1.31 per square yard. Had the cost of grading, excavation and culverts been added to the above, the cost of pavement would have been increased to $8.73 per cubic yard or $1.46 per square yard.

The following work was constructed in the north central part of Illinois during October and part of November of last year: The road is 5,500 feet long, 12 feet wide and has a uniform thickness of 6 inches. The total cost, not including water, macadam shoulders and equipment, was $7,089.42. The equipment consisted of a ½-yard Koehring mixer and road grader, plows, scrapers, road roller and the necessary wheelbarrows and shovels. The cost was as follows:

2,274 barrels cement	$2,333.65
720 yards sand	582.49
1,185 yards gravel	1,787.93
Operative cost of mixer	51.99
Baker plates and creosoted wood blocks for expansion joints	160.03
Labor	2,282.52

The total of these figures determines the cost per cubic yard as $5.80 or $0.96 per square yard. No information was obtained on the cost of water for this work.

Carl M. Boynton,
Inspecting Engineer Universal Portland Cement Co.

Make Your Own Blue Prints

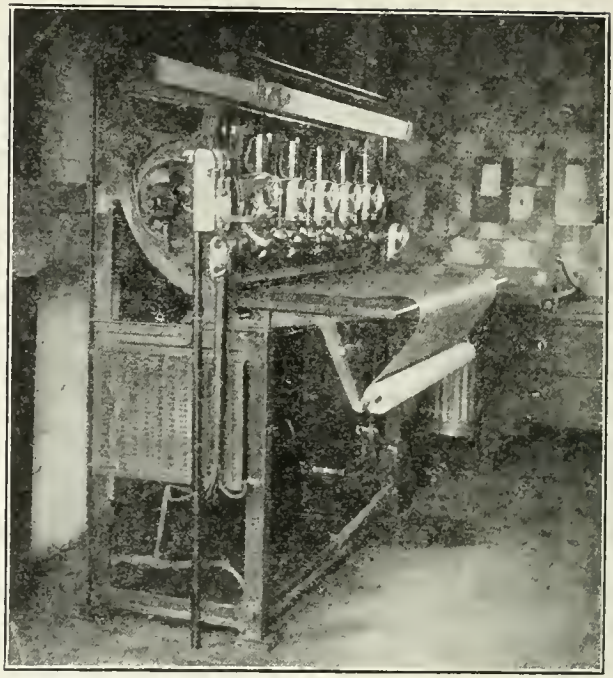
The Editor of Municipal Engineering:

Sir—We have your communication regarding the blue print machine which we have in operation, and it is with pleasure that we give the information you request.

The Pease blue print machine which we have in operation is a model for efficiency, economy and productive capacity. It is for these reasons that it was selected from among other machines, and it is serving its purpose admirably and beyond expectation. In order that its advantages may be more fully understood, the following description will be enlightening if used with the accompanying photograph.

The machine is built on a cast iron

frame about 50 inches in length, 30 in width and 60 in height. A table is attached to the operating side by means of a pair of brackets which are integral with the frame. Below the table are two steel rods ¾ inch thick, upon which the rolls of blue print paper may be placed. The paper is unrolled so that the sensitized side is uppermost on the table, where the tracing or whatever is to be copied may be laid upon it. Directly to the rear of the table is a quadri-cylindrical piece of plate glass, extending the full length of the machine, its concave side toward the operator, its lower edge parallel with and slightly above the edge of the table. A canvas belt, which is as wide as the glass, revolves about two rollers, one of which is placed at the uppermost edge of the glass and the other below the table. The bearings in which the roller runs are placed on rocker arms which are under spring tension, thus causing the canvas to bear upon every portion of the under or convex side of the glass.



PEASE *blueprinting machine, from which the National Brake and Electric Company secures an average monthly output of* 2,000 *large tracings,* 4,000 *half size, and* 10,000 *quarter size.*

The tracing having been placed upon the blue print paper, both are started into the machine.

The printing light consists of a row of five arc lamps, which are supported, parallel to the glass, upon a conduit pipe, which carries the wiring for the lamps. Each lamp is provided with a separate switch and a shield to keep the intense light from the eyes of the operator. The lights approximate 1,000 c.p. each and are so arranged that they may be tilted backward upon the table to be trimmed.

The motive power is supplied by a ¼-h.p. electric motor and is transmitted to the rollers by bevel gears. By means of a sliding gear transmission, which permits of two changes of speed, and a regulating reostat, the speed of the machine may be varied from an almost imperceptible motion to the highest speed practicable for blue printing.

The paper coming out of the top of the machine goes toward the rear and is rolled up in a sheet iron trough provided for that purpose. The tracings fall into a similar trough, which is between the operator and the arc lamps, and which may be slid up and out of the way when trimming the lamps. A fan is attached to one end of the machine to carry away the intense heat caused by the arc lamps.

The entire construction of the machine is very rigid and there is no expense of maintenance except that of replacing cracked glasses for the arc lamps and the carbons, which burn continuously for a day.

The cost of operation is low considering the speed with which tracings are printed. The large size tracings are printed in thirty seconds on fast brands of paper, and forty on the slow brands, while a new tracing which is not soiled may be printed as fast as fifteen seconds.

The printed rolls are taken from the machine and cut into lengths of about 60 inches. These are folded thru the middle and placed in a tank about 50 inches square, containing a solution of potassium bichromate. They are allowed to remain here until perfectly blue, when they are hung up and the surplus moisture is drained from them. They are then placed in a drying oven, which

consists of a sheet iron box about 4 feet high, 3 feet wide, and 5 feet long, in the bottom of which is a set of steam coils. The prints require about five minutes to dry, when they are cut to size and delivered. If a print is desired sooner than this it may be reversed and put thru the machine again, which dries it in about thirty seconds.

The average monthly output is two thousand large size tracings, four thousand half size, and ten thousand quarter size sketches, and miscellaneous drawings. Altogether about fifteen hundred yards of blue print paper are consumed.

The largest number of prints made in one day is 2,125, of which 225 were full size, 350 half size, 1,550 quarter and miscellaneous sketches and odd sizes. The department employs three young men, who graduate eventually into the drafting room. One of these operates the machine and finishes the prints, while the other two deliver them and keep account of them, also collecting all old prints which are superseded by new designs.

This machine is manufactured by the C. F. Pease Co., of Chicago.

Our blue printing department is located immediately above the drafting room to facilitate delivery of tracings and general communication. It is operated in conjunction with the photographic department and the writer has charge of both departments.

National Brake & Electric Co.
F. H. Commander,
Staff Photographer.

Protect the Concrete Where Work Is Suspended

The Editor of Municipal Engineering:

Sir—From various causes, work on any part of a concrete structure is liable to be suspended from a couple of days to a week, or even weeks or months in some instances. A halt of this kind, in the work, is usually at some definite junction point, such as the top of a footing or abutment if it be bridge construction. The forms protect the concrete on all sides except the top, the part on which the added structure will rest. This is written as a note of warning to those builders who so carelessly leave this exposed top unprotected from the summer sun and wind.

In most instances the concrete is made wet, poured, and the forms protect the sides from immediate loss of moisture, but the exposed top may be dry almost before the final set has taken place. This drying of the surface must necessarily leave a weakened surface.

We would consider it bad practice to leave a thin layer of sand or earth between an abutment and its foundation, or the abutment and the arch which it carries, but "burned" concrete is little if any better. If it be continuous work, this weakened top can be picked off, but if this top line comes to a finished line, as it most often does, the removal of the top will disfigure the work.

The only safe way is to protect all top surfaces from sun and wind and keep them supplied with sufficient moisture for proper curing. H. A. MARK.
Gering, Neb.

Los Angeles Needs Storm Sewers

Every heavy rain in Los Angeles is followed by a flooding of the streets that carry off the water from districts without storm sewers. The only way to get across some of the streets dry shod is to wait for an obliging driver and get a lift in his wagon. This condition led one of the councilmen of that city to propose a plan, which was successfully carried out last winter, to utilize the street sprinkling teams and drivers, which were idle during the winter, to haul portable bridges and planks and set them from the curb at the flooded crossing, anchoring them by wire to the nearest telephone post. After the storm they were collected and removed to a storage place until needed again.

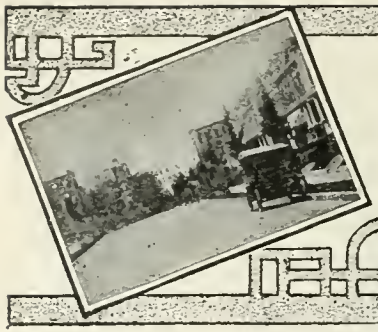
St. Paul's Paving Plan

1.—The city shall do its own work in all cases and shall not abandon that principle until the city engineer shall officially notify the board of public works that it can not do no more work.

2.—Creosoted blocks shall be the preferred pavement on all heavily traveled streets and all residential streets where th value of the property will justify the cost, and the grades are not too steep. On all steep grades sandstone shall be used.

3.—On all streets, where a cheaper pavement is required, on which there are street car tracks, brick or some other substantial lower priced pavement, other than asphaltic concrete, shall be used.

4.—On streets where there are no street car tracks and where traffic is light and the property values necessitate a cheap pavement, asphaltic concrete shall be used—the mixture to be manufactured by the commissioner of public works, under specifications devised by him and the city chemist, which will not infringe upon any patented pavement.



ROADS AND PAVEMENTS

Petrolithic Road Construction with Costs of Construction and Maintenance.

By K. F. Postle. Los Angeles. Cal.

The use of oil on roads in California goes back perhaps about 30 years, but it was first merely splashed on the roads irregularly and indiscriminately. Real construction dates back only 8 to 12 years. Perhaps the real beginning of constructive work may be set at about 12 years ago, when a road builder in Kern County invented a sheep's foot tamping roller, now known as the petrolithic rolling tamper, and began to compact roads with it.

There are in southern California (the particular home of "oiled" roads) 1,500 or more miles of liquid asphaltic roads that may be considered as passably well built. There are hundreds more miles of oil-splashed roads, which are an improvement over the original dirt and sand roads, but can not be considered as modern liquid asphaltic constructed roads. These roads have been a very great element in the unparallelled development of southern California. Some of them are very cheap construction and are not to be compared with costly pavements; but in spite of cheapness they have served their purpose more effectively at less cost than any other county road system in any other part of America has served its community. No matter how wet the weather one can go practically all over the settled parts of southern California without getting into bad mud. No matter how dry, one can go almost everywhere without getting into bad sand or dust. Because of these roads our teamsters regularly haul two, four, six, eight and ten tons at a load—loads which ordinary eastern teamsters would consider as horrible nightmares. Because of these roads our people go about freely and easily thruout the entire section. Because of these roads, together with our equable climate, automobiles are in universal practical use. Automobiles have become invaluable in modern life, as incalculably increasing the range and amount of a man's capacity and activity.

The cheapest of these roads, which may be considered passably well built, have cost less than $1,000 per mile. The upkeep of these cheaper roads has varied under different circumstances between $25 and $50 per mile per year. As population and traffic have increased (and they have increased in many cases with overwhelming rapidity) the cheaper roads have been or are being replaced with more costly construction to meet the increased demands. The great increase of traffic which must be provided for may be gaged in some degree from the fact that many of our outlying country roads carry more and heavier traffic than the ordinary streets of many cities of the east having a population of 20,000 to 30,000.

Several streets still exist in South Pasadena which were petrolithic built nine or ten years ago of merely the native soil and oil at a cost of about 18c per square yard. These streets have had no repairs and though not in A1 condition, are yet so good that the city does not consider that they have to be repaired and the residents think the same.

Glendale, Los Angeles County, has a number of miles of liquid asphaltic streets, petrolithic built, using only the native sandy soil as it lay in the roadway. Most of the streets have been in use four, five and six years, have had no repairs, and are today equal in appearance to many of the sheet asphalt streets in some of the eastern cities, though not so hard. The Glendale streets cost from 18 to 35 cents per square yard.

CONSTRUCTING *an asphalt macadam street at Whittier, Cal. A petrolithic tamping roller is in the foreground.*

The country town of Lemoore, in Kings County, California, has several miles of liquid asphaltic streets, petrolithic built, with only the native sandy soil, at a cost from 14 to 18 cents per square yard. These streets lasted seven years before it was thought necessary to make any repairs on them.

After four to six years of use, pavements costing 25 to 30 cents per square yard are in excellent condition.

Monrovia, in Los Angeles County, has over 25 miles of asphaltic streets, most of which have been in service from four to six years. These streets are petrolithic built, using just the native soil, which, however, is an excellent granite gravel lying on the mountain slope. No expenditure for upkeep has been put on many of these streets, altho they are subjected to comparatively heavy trucking and auto traffic. On the few streets that have been retouched as yet the expenditure has been so slight that the street department has considered it negligible. The cost of construction has ranged between 25 and 30 cents per square yard. These streets are so good that visitors usually think that the pavement is costly sheet asphalt.

Ventura, California, has over 13 miles of liquid asphaltic streets, which were built about four years ago at a cost of about 58 cents per square yard. These pavements are a form of petrolithic built liquid asphaltic macadam. Some of them show some minor defects of construction, but as a whole they are considered by many of the residents as equal to sheet asphalt. Certainly no other equal aggregation of streets that cost less than $1 per square yard will stand comparison with them. There are no records of upkeep expenditure of any sort on them as yet.

Santa Ana, California, has several miles of liquid asphaltic streets which have been in service about three years. They are petrolithic built, asphaltic macadam, and cost between 59 and 68 cents per square yard. These pavements are on several higher class residence streets and side business streets, and are deemed by most of the residents superior to regular sheet asphalt. No repairs have yet occurred on the streets.

About 6½ miles of road lying along the foot of the mountains back of Pasadena, and constituting a link of the Los Angeles County good road system, was petrolithic built about two years ago, using only the soil of the mountain slope, which bears a large proportion of granite gravel. This road carries a great deal of automobile and hauling traffic and is subject to the wash of heavy mountain rains, yet it is proving superior to the great mass of much more costly 8-inch asphalt macadam laid about the same time. It is deemed one of the best pieces of road in the system.

North Grand ave., in Pasadena, has been under service for six years without any outlay for repairs. It is petrolithic built, liquid asphaltic macadam, and is in excellent condition today.

Pasadena has many miles of asphaltic streets of various grades and variously built. Its asphaltic macadams range between 1 inch and 6 inches in thickness of the actual stone pavement. Some of these streets carry a traffic of 1,000 to 1,500 automobiles a day, besides other light and trucking traffic. Some of the streets have records of very heavy haul-

ing. The asphaltic macadam pavements cost from $1 per square yard downward. Most of them have called for no repairs as yet. The extreme cost of repair, when misconstruction made necessary a partial reconstruction of the pavement, has been 4.5 cents per square yard or less; this cost covered scarifying and reshaping the entire surface, and pavements so treated are now A1.

The proper use of the petrolithic tamping roller is essential to the ultimate success of this type of pavement.

The petrolithic tamping roller is an implement to accomplish better compaction with greater ease and surety. But this increased efficiency of compaction can be accomplished only by using the implement in the proper ways. It has been so used many times as to gain nothing but trouble, expense and delay in the work.

The tamping roller is not a pressure roller in the same sense as the ordinary smooth roller. The ordinary smooth roller compacts by direct pressure of great weight, the tamping roller compacts by the thrust and pound of a small shoe with a small face. The smooth roller depends on the material giving evenly under it to irregular depths and the particles slipping over each other so readily as to fill all voids tight and to perfect compaction. This action, however, rarely takes place perfectly, for some parts tend to compress more quickly than others and then to carry the roller over the less compacted parts lying between. Hence the resulting compaction is usually uneven, spotted or streaked, and not positively reliable.

The tamping roller aims to compact a distinctly defined layer of material with approximately perfect uniformity. The layer of material is first loosened, evenly mixed and usually puddled to insure uniformity. It is then pounded, or tamped, by repeated going back and forth with the tamping roller until solid enough for the purpose in view. There can be no streaks or spots if the work is properly done.

The tamping roller will not efficiently compact a narrow, soft streak that lies between two hard streaks, or in equivalent position. It will not compact a small soft spot that lies in the midst of hard material. Such conditions indicate that the materials and process are not being properly handled. Since the tamping roller is composed of two rolling drums, each three feet in length and both mounted on the same axle, it inevitably follows that, if the soft place is too small for the roller to sink into across its entire length, the roller must necessarily bridge across to some extent and fail of perfect compacting. Even in such cases, however, it will often assist in discovering where such soft spots exist, though they may have been passed as perfect by a smooth roller. But proper effective tamping, to repeat, is accomplished by loosening the entire material to such a depth as is needed, evenly mixing it and then tamping it all down evenly in a uniform compaction. It differs from ordinary pressure compaction also in that it compacts from the bottom upwards instead of from the top downwards.

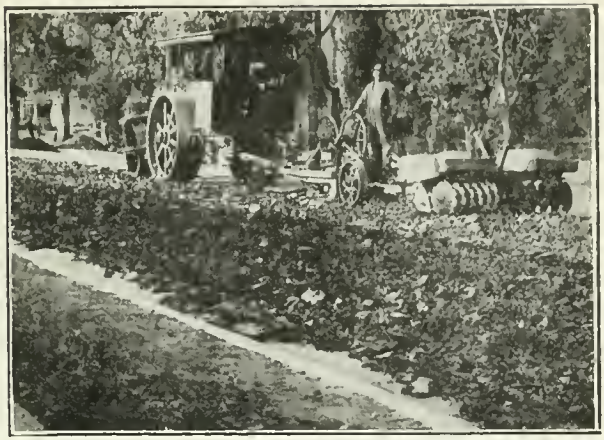
This compaction is of value in any work with earth, sand, gravel and similar materials, where there is need of increased density or increased carrying power. It is of especially great value in settling fills, in dam construction, including compaction of reservoir bottoms, and in roadway foundations. A signal instance of such compaction on a larger scale than common is that of the 52,500,000-gallon earth reservoir for oil, constructed in 1911 near San Luis Obispo, Cal., by the Union Oil Company of California. The material used contained 40 to 60 per cent. clay, any falling under that proportion being rejected. Sixty-four thousand cubic yards gross was compacted into 49,000 cubic yards in place, including some waste in handling and trimming. The supervising engineers estimate that the compaction was over 22 per cent. A cross section of the embankment, cut through to lay a pipe connection, showed no stratification; the entire embankment pared down from top to bottom like an extremely hard pressed cheese.

In applying the tamping roller to roadway construction there are certain definite principles to be kept in mind. Compaction by tamping primarily increases the carrying power of earth, sand, gravel and similar combinations. Secondarily, because of the increased density and carrying power, the wearing quality is increased, but not in equal proportion to the increase of carrying power.

A roadway of earth, sand, gravel or similar materials, when properly compacted with the tamping roller, is tremendously improved, but it still has the essential qualities of a roadway composed of such materials. The increased compaction does not make it over into the class of hard-metalled roads, as some extreme enthusiasts have seemed to assume and expect. If good road asphalt is properly worked into the surface of such roadways, the wearing quality is even more greatly increased, almost unbelievably increased in the case of particularly suitable materials; but the roadway, nevertheless, still lacks some of the wearing quality of a hard-metalled roadway. However, an important exception must be made to these

statements regarding gravel, in that if the gravel carries a large percentage of stone of good quality, the resulting roadway becomes distinctly an approximation toward a hard-metalled roadway, with similar wearing qualities. If this latter grade of gravel is properly combined with good asphalt, the result is an approximation towards an asphalt-concrete, with similar wearing qualities.

The term "petrolithic" is not meant to designate any particular pavement or type of pavement, but to designate methods of construction applicable to almost every type of roadway and pavement. There are earth, sand and gravel roadways in which the tamping was carried clear to the top, sometimes with and sometimes without using any asphalt. There are gravel roadways in which only the base was tamped, and then a wearing pavement of gravel smooth-rolled over it; in such construction asphalt is usually used in the gravel paving, though not nearly always in the base. In asphalt macadams tamping has been used to various extents; we recommend its use with macadams chiefly in the base. Tamping is used to compact earth and gravel bases for asphalt concretes, for cement concretes, etc. In every case, however, it should be remembered that the tamping roller is not a road-finishing (surfacing) implement, but a compacting implement.



WEST ADAMS STREET, *Los Angeles, Cal., pavement under construction. The city owns the outfit shown, which consists of a fifteen-ton Monarch roller, a petrolithic gang rooter, and a Hatch disc harrow.*

We regard a highway as composed of two great essential parts, which involve in themselves all other elements. The first is a carrying base or fonndation; the second is a wearing surface or pavement. These may be combined in many ways, but a roadway must be planned from the standpoint of these two phases and must stand analysis according to them. In general paving of the more rigid heavy traffic type, such as concretes, blocks, etc., the tamping roller comes into service in compacting and uniformly developing the carrying power of the base. Maximum compaction and carrying power in the base enable the use of minimum thickness in wearing pavement above and at the same time insure more satisfactory and more enduring qualities in the roadway. The modifying relationship of these two parts of a roadway's make-up with each other and with reference to the result desired should be kept clearly in mind in planning or judging a roadway, if one is to plan or judge practically and effectually. Often materials that are cheap under local conditions may be so handled as to have compaartively (compared with needs) unlimited carrying power. The immediate wearing surface, however, should be formed of as efficiently hard metal as is practicable, all things considered. The great work of the tamping roller is to increase the efficiency of the base, to enable the use of locally cheaper materials in the base, to decrease the amount of wearing surface paving needed or increase the efficiency of what is used, and thus to produce a more resilient satisfactory roadway.

Considering traffic as the absolute condition, one might make the absolute statement that only a hard metal paving would give efficient results. But in actual practice traffic is only one of a number of conditions to be considered. The practical road builder must balance up together many conditions and make modifications accordingly. A hard metal surface becomes in many cases merely the ideal toward which to strive as far as posssible. Among many variants at least two modifying considerations may be taken to enter into the designing of every roadway. The first is the amount of funds available for construction. The second is the comparative value of the different styles of roadway possible, reckoned thru a stated period of years, which period must be determined by the various local conditions. Such comparative valuing must consider among other things the original cost or investment, the maintenance cost thru the determined period of years, the condition, or rather value, of the road-

way at the end of the period, the service value to the taxpayers or investors of each style of roadway, which service-value should take careful estimate of the destructive wear of each style of roadway on the animals and vehicles which pass over it—an item often entirely overlooked, which, nevertheless, has to be paid by the users of the roadway. These values should be carefully estimated from real practice and not from mere abstract engineering theory.

A careful study of traffic conditions necessary in order that a community can be sure of the most economical, permanent road.

The result of such comparison may determine that merely a good dirt road is the most economical for a given community, or a sand-clay road, or a gravel road, etc. As an instance in illustration the writer has several times, after summing up all the elements of the situation, had occasion to recommend a thoro compaction of the natural earth base by tamping and addition of one-half to one inch of hard gravel or crushed stone, with asphalt, for a wearing surface, in the case of light traveled country roads or small town residence streets, because, under the conditions pertaining, such construction involved exceedingly low first cost and exceedingly low maintenance cost and at the same time gave an exceedingly satisfactory and easy-running roadway for the traffic concerned.

Whatever the type of roadway or paving, petrolithic methods in connection with it stand for greater compaction, for greater uniformity of compaction, for greater and more dependable carrying power, for enabling the use of cheaper local materials underneath, for greater resiliency and consequently for greater economy in construction and maintenance and greater satisfaction in traveling quality. But the methods are not in themselves cheap methods, tho they may result in much lower cost of roadways. Compaction by tamping roller is usually somewhat more costly than by ordinary methods. Economy comes from the increased durability and satisfaction of the resulting roadway and from decreasing the expenditure and work necessary in certain other costly parts of the construction. In many constructions this economy shows strongly in the first cost; in other constructions it becomes evident only in the "period" cost.

The petrolithic gang rooter.

The petrolithic gang rooter, or rooter-scarifier, is a combination of plow, rooter and scarifier. It is built powerful enough to withstand the draft of the most powerful traction engine. It is greatly used by cities in connection with their road rollers for repair work on the dirt, sand, gravel and macadam streets. It will tear up anything that any traction can pull it through.

It does not depend on weight to force it into the ground, but has an essential tendency to dig, and must be held by the adjustment of the wheels from going deeper than is desired. Its operating width is five feet; it will tear up this width more easily than a moldboard plow will tear up one-fourth of that width. The five points, of specially tempered steel, are set at such an angle that they lift the loosened material with a shoveling action, sliding it into curved standards above to be finely broken; they are arranged in wedge formation so as to minimize draft and produce balanced action. The frame carries on three points—two rear wheels and one front truck; each of the three points adjusts separately, giving range of adjustment and ease of operation.

The gang rooter breaks the ground or roadway more easily and more finely than any other implement. It holds exactly to place, missing nothing. Street superintendents, road men and contractors find it invaluable in street work, road work and grading because it breaks to just the depth set, neither shallower nor deeper; it breaks to a regular level independent of ordinary ruts or depressions; it cuts thru everything in its way instead of being thrown out of course by obstacles and missing places; it stands the strain even if the obstacle is sufficient to stop the engine dead. In brief, the gang rooter is balanced in action, easy of draft, easy of operation, rapid in work, positive and uniform in cutting depth, unlimited in breaking-up power, durable under all conditions, more effective in work, more varied in its range of work.

It is used in all sorts of difficult street work, in difficult road work, in difficult grading and in difficult excavating. It is also being used agriculturally for difficult conditions. It is used where the ground is too hard for anything else. It is used to drag large boulders out of stony soils. It is used to tear large roots out of newly cleared land. It can be adjusted so as to have clearance equal to almost any usage.

The petrolithic rotary, or spike disc scarifier, operates on the same principle as a disc harrow, having, however, such weight and strength as is never thought of in a disc harrow. Instead of cutting discs, it has heavy cast discs in which are set powerful cutting spikes made of specially tempered steel and peculiarly curved. The implement is drawn back and forth over the surface to be scarified

or the clods to be pulverized until the required work is accomplished; the draft is from four to six horses. As the discs revolve the spikes are driven into the street or ground or clods by the force of impact and the weight of the implement; they cannot then be drawn out direct, but must tear their way out, ripping several inches in their passage. One of its many uses is to pulverize clods, particularly if they are too difficult for other implements or extra rapid work is needed. Another use is to scarify the surface of dirt, sand, gravel and macadam roadways without disturbing the solid base beneath. It is especially valuable on asphaltic streets where the asphalt tends to loosen in cakes and entirely clog the ordinary type of scarifier; in such cases it has enabled a light repair as required at a very low cost.

Street Paving in Toledo, Ohio

The city of Toledo, Ohio, has a peculiar foundation, much of the city being located on ground reclaimed naturally from Lake Erie in very ancient days and this being rather low and flat, tho its location near the lake is such that floods in its rivers can not disturb its equilibrium. The soil does not form a very satisfactory foundation for pavements, and difficulties with which other cities contend occasionally must be met here in a large part of the work.

The department of public works is able to cope with its problems and a trip over the streets under its charge shows conditions fully equal to the average of cities if not a little better.

The city engineer, George W. Tonson, has been connected with the department as commissioner or city engineer almost continuously for many years and the excellence of the work in the city is undoubtedly due in large part to his careful and conscientious attention to his duties.

Mr. Tonson is a member of the American Society of Municipal Improvements and a member and committeeman of the Society for Standardizing Paving Specifications, and he is using in large part the specifications adopted by the latter organization, which differ but little from those adopted by the former.

Some features of the Toledo paving specifications.

The latest edition of the Toledo specifications for street improvement provides for light gravity oil (1.03 to 1.08) and 16 pounds to the cubic foot of yellow pine, but several streets have been laid with blocks treated with heavier oil. The specification for asphalt is somewhat more open than the latest form of the standard specifications and several kinds of asphalt have been used with good pavements of almost every kind. Brick pavements have been laid with sand, asphaltic and cement fillers and the results seem to depend more upon the character of the foundation than upon the method of laying the wearing surface.

Wakeman street on a broken stone foundation with brick wearing surface and sand filler for joints was laid about twelve years ago and is in good condition, but there are many others of similar specification and less age which are in poor condition. Smith street, in front of the city stable, is of brick on concrete foundation with sand filler. It is five years old, in good condition and has had no repairs.

In asphaltic and bituminous pavements, similar results may be reported. Collingwood avenue was recently resurfaced after twenty-four years of wear at a cost of $1.20 a square yard. Madison street, fourteen years old, is in good condition. A number of old stone pavements have been improved by covering them with asphalt, usually with a binder coat about 1.5 inches thick and a surface coat 2 inches thick. The city has been very successful in this line on such streets as Euclid avenue, where the old Medina stone pavement was covered at a cost of $1.12 a square yard; Huron, from Adams to Jefferson, covered six years ago with California asphalt; Erie street in several sections, two to four years old, covered with asphaltic concrete, about 3.5 inches thick, using Trinidad asphalt.

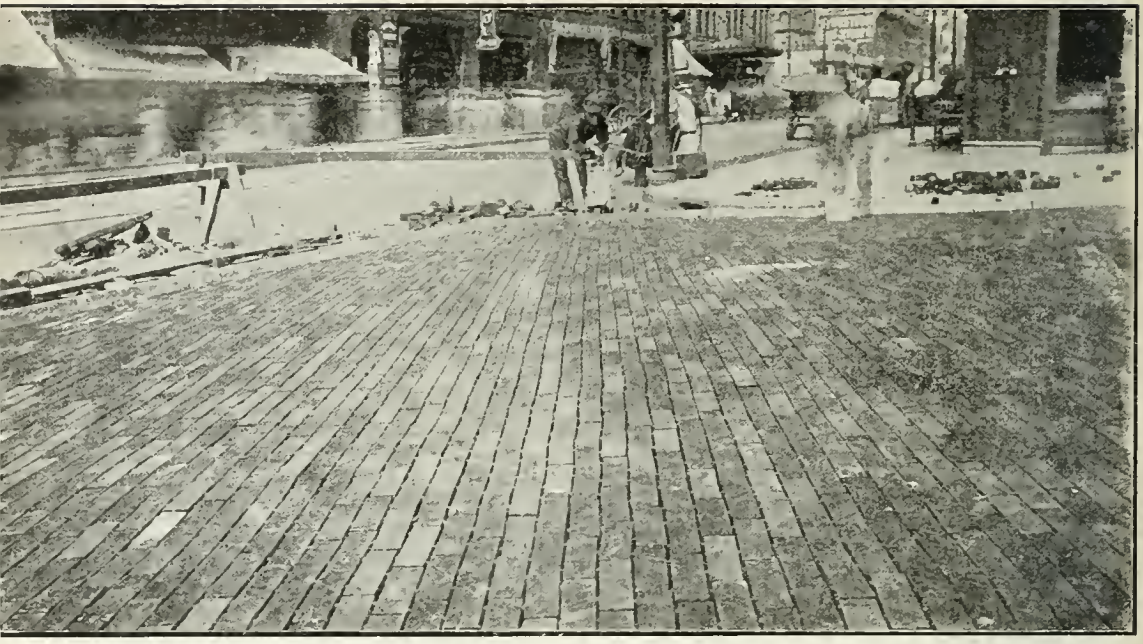
A new asphalt pavement on Main street, on the east side, laid in 1912, where traffic is heavy and concentrated by the street railway tracks, promises specially good wear, attributed by Mr. Tonson to the use of 11 per cent of bitumen in the top mixture.

The city is operating a new municipal asphalt plant, one of whose products in 1912 was West Woodruff street, which cost 98 cents a square yard for a thickness of 1.5 to 2 inches.

East Woodruff street has a bitulithic pavement laid in 1906 with broken stone foundation, which is in excellent condition.

But little stone is now used, a section of Lafayette street, laid with granite in 1912, being the latest.

Some asphalt block pavements were laid ten years ago or so. One in Parkwood avenue, laid in 1903, is in bad condition, especially when compared with another section of Parkwood avenue, laid in 1900 with creosoted yellow pine, 12 pounds of oil to the cubic foot, which has had no repairs during its life and is now in good condition.



JACKSON AVENUE, *Toledo, O., creosoted yellow pine wood lug block pavement under construction. Grade over 3 per cent.*

Toledo has about 10 miles, 200,000 square yards, of creosoted wood block pavement, Parkwood being the oldest. The next wooden block street laid was Monroe, 2.25 miles long, laid in 1904, using 16 pounds of oil per cubic foot of the yellow pine blocks. The wooden blocks are laid between the street car rails and there has been no repair required on this street during its nine years of life. In 1905 five streets were laid with 3-inch blocks, using 16 pounds of oil per cubic foot and three streets with 4-inch blocks, using 10 pounds of oil per cubic foot. In 1910 St. Clair street was laid with 3.5-inch blocks, using 16 pounds of oil, and Huron and Superior streets, old Medina stone pavements, were resurfaced with 3-inch yellow pine blocks, using 16 pounds of oil per cubic foot.

One block of Jackson avenue, from St. Clair to Summit, where the grade is over 3 per cent., was laid with yellow pine lug blocks. These lugs are cut two on one side and one on an end of each block and serve to separate the blocks instead of using a lath to separate them in the process of laying. The lug block pavement can be used on a street with heavy grade, even heavier than that of Jackson avenue without danger of horses slipping. A team was observed hauling 50 cubic feet of sand up the Jackson street grade without hesitation or fear of slipping. The joints of this pavement were filled with sand, but a compressible pitch filler can be used. The blocks used on this street were treated with 16 pounds of oil of 1.08 to 1.10 gravity and have bled to some extent. A light dressing of slag sand is applied at intervals to all wooden block pavements. The dressing lasts about a year and seems to be beneficial to the durability of the street as well as to help take care of the bleeding of the blocks. The lugs are compressed when blocks swell and thus take care of the expansion from absorption of moisture. All wood blocks in Toledo are laid on a mortar bed without sand cushion.

An old stone pavement on Huron street was covered with about an inch of cement mortar and wooden blocks were laid on this bed before it had set.

The only concrete pavement observed was under the sheds of the new wholesale-market house where it is protected from the weather. This pavement was laid in the fall of 1911 and is in excellent condition with but few cracks.

The activity of the city in paving matters is shown by the fact that 53 contracts for street paving are under construction.

Macadam Road Construction Statistics.

By John McNeal, M. Am. Soc. C. E., City Engineer, Columbia, S. C.

A MONOPOLISTIC corporation has been termed one whose operations are not subject to the effect of competition. Municipalities may in a measure be classed under this head, but while actual competition is wanting in the business operations of a city, many opportunities are presented for comparative cost accounting, which should have a tendency to create competition and materially reduce the cost of municipal work.

Physical statistics and cost accounts properly utilized reveal leaks in the management of municipal departments, which the wide awake official will endeavor to correct.

The following tabulated statements show the cost of macadam work done under the supervision of the writer in Easton, Pa., during the years 1906 to 1909 inclusive. These statements show the cost of the work in detail as well as the calculated depth of the finished road. In calculating the depths, it was assumed that a cubic yard of loose stone weighed 2,400 pounds and that 1 6/10 cubic yards of loose stone compacted to one cubic yard. In some cases the depth of finished road slightly exceeded this calculated depth due to the variation in weight of the material.

The increases in rates of labor, etc., during the year 1907 and the years following, show a proportional increase in the cost of the work.

Cousiderable variation is shown in the cost per square yard for sprinkling and spreading crushed stone. The former is due largely to weather conditions and the latter to the delivery of the stone on the street, delays in delivery increasing the cost.

The change in price of crushed stone from year to year as shown on the attached statement, also altered the cost per square yard of the crushed stone item.

COST PER SQUARE YARD OF MACADAM WORK IN THE CITY OF EASTON, PA., FOR THE YEAR 1906.

Street	Width, ft.	Length, ft.	Area, sq. yds.	Calculated depth	Cost in Cents per square yard. Grading	Crushed Limestone	Spreading Stone	Crushed trap rock	Sprinkling	Rolling	Drain pipe	Total cost
Taylor Ave, first section....	700	20	1555	4 3/4	..	21.8	3.2	...	1.2	1.3	4.4	31.9
Taylor Ave., second section..	825	20	1833	4 1/2	9.6	21.0	2.6	...	0.3	2.0	..	35.5
Delaware River Road.....	2100	12	2800	5 1/4	..	23.0	1.8	...	1.2	1.4	..	27.4
Burke	1272	30	4240	4 3/4	3.9	22.0	1.9	...	0.6	1.5	0.8	30.7
Brodhead	334	30	1113	6 1/4	0.8	28.8	2.9	...	0.5	1.5	..	34.5
Sitgreaves (Terry-Lehigh)..	470	9	470	6 1/4	..	10.8	1.6	30.5	0.7	2.6	2.8	49.0
Second	230	30	767	4 1/4	8.0	18.8	2.5	...	0.7	1.6	..	31.6
Green	480	9	480	3 1/2	..	14.3	4.9	...	1.3	1.7	..	22.2
Terry	480	27	1440	4 3/4	..	1.8	2.8	34.0	1.0	2.1	..	41.7
Bushkill (Fourth to Pearl)..	400	13	577	6 1/4	..	28.2	6.7	...	4.0	2.1	..	41.0
Wood (Seventh-Eighth)	440	18	880	4 1/4	1.7	18.8	1.7	...	0.3	..	..	22.5
Dock	1700	10	1888	3	..	9.5	1.6	6.8	0.8	1.4	..	20.1
Fourteenth	450	30	1500	4 1/2	1.5	19.9	2.4	...	0.3	1.1	2.2	27.4
Bushkill (12th-13th).....	470		990	5 3/4	3.9	26.0	1.4	...	0.2	2.5	1.2	35.0
Spruce (12th-13th)	470	10	522	3 1/4	..	14.4	1.7	...	..	0.8	..	16.9
Valley Ave.	300	24	800	5	..	22.6	2.0	...	1.2	1.5	3.8	31.1
Milton Ave.	770	24	2053	5	5.2	22.9	2.2	...	1.0	2.0	1.4	34.7
Average												31.4

COST PER SQUARE YARD OF MACADAM WORK IN THE CITY OF EASTON, PA., FOR THE YEAR 1907.

Cost in Cents per square yard.

Street	Length, ft.	Width, ft.	Area, sq. yds.	Calculated depth, in.	Grading	Crushed limestone	Spreading stone	Crushed trap rock	Sprinkling	Rolling	Drain pipe	Hauling and Breaking	Total cost
Bushkill (2nd-3rd)	500	30	1667	6	3.2	23.8	2.9	9.4	1.0	3.7	..	...	44.0
High	300	30	1000	8 1/2	1.5	40.6	2.9	..	1.4	3.3	..	...	49.7
Parker Ave.	1300	14.75	2130	6 1/2	6.7	32.1	4.2	..	1.2	2.9	4.4	...	51.5
McCartney (Monroe-Pierce)	320	30	1067	9	4.2	43.7	2.9	..	1.3	2.7	..	...	54.8
Union	380	11	464	3 3/4	...	18.2	3.1	..	0.8	2.3	..	...	24.4
Bushkill (8th-10th)	715	22	1748	4 3/4	3.5	23.2	2.5	..	1.3	2.0	..	...	32.5
Bus'ill (W'd-12th)	250	30	833	4 1/4	10.8	20.9	2.4	..	1.0	1.6	..	...	36.7
Washington (7th-Walnut)	600	31	2043	4 1/4	...	20.0	2.0	..	1.0	2.0	..	...	25.0
Lincoln (C'l-Centre)	765	24	2040	4 1.4	1.2	20.7	1.9	..	0.5	1.9	..	8.1	34.3
Wilkes-Barre	520	24	1387	4 1/2	8.5	22.2	2.4	..	0.8	1.3	..	...	35.2
St. John	722	18	1444	3 3/4	7.9	16.4	1.9	2.2	1.3	1.0	..	...	30.7
Kleinhans Ave.	500	18	1000	3 1/2	...	17.1	2.0	..	0.9	3.1	2.2	17.4	42.7
Berwick (Cen.-Val.)	1220	14.5	2899	7	11.0	33.5	3.7	..	0.9	4.4	..	...	53.5
(Davis-Coal)	360	24	960	3	1.7	14.0	1.3	..	0.5	1.4	..	...	17.9
Berwick	360	24	960	3	1.7	14.0	1.3	..	0.5	1.4	..	...	17.9
Lincoln	360	24	960	5 3/4	...	27.6	3.2	..	0.5	2.3	..	...	33.6
Northampton St. (6th-7th)	990	27	2970	4 1/4	...	16.5	2.2	4.8	0.9	1.2	..	...	25.6
Average	...	..	....	....	...	...	..	..	..	..	..	...	37.0

COST PER SQUARE YARD OF MACADAM WORK IN THE CITY OF EASTON, PA., FOR THE YEAR 1908.

Cost in Cents per square yard.

Street	Calculated Depth, in.	Length, ft.	Width, ft.	Area, sq. yds.	Grading	Crushed Limestone	Trap Rock Screenings	Spreading Stone	Hauling and Breaking	Sprinkling	Rolling	Drain Pipe	Total Cost
Northampton (7th-11th)	4) 4)	978 726	30 15	4470	1.2	22.3	...	1.4	..	1.1	1.5	..	27.5
Cattell	5	758	25	2106	1.6	27.4	...	2.2	..	2.3	3.3	..	36.8
Paxinosa Ave.	4 1/4	400	25	....	...	...	...	...	..	..	..	..	...
		410	12.5	1680	1.3	23.6	...	1.4	..	1.0	1.8	..	29.1
McCartney (Pierce-Burke)	6 1.2	308	30	1027	12.5	36.6	...	3.3	..	2.8	3.8	..	59.0
McCartney (Parsons-Monroe)	6	333	30	1110	7.1	33.9	...	2.8	..	1.6	2.4	..	47.8
Mulberry	4 3/4	237	10	263	...	26.7	...	3.1	..	1.1	1.8	..	32.7
Monroe	4	270	30	900	0.4	22.3	...	2.6	..	1.1	2.2	..	28.6
Butler (10th-11th)	3 1/4	961	22	2349	1.3	15.4	1.5	1.6	..	1.3	2.4	..	23.5
Wood (11th-Bushkill)	5 1/4	300	30	1000	...	28.8	...	3.3	5.0	1.6	2.6	3.9	45.2
Wood (8th-9th)	4 1/2	450	30	1500	1.7	25.4	...	2.3	7.5	0.8	2.1	..	39.8
Old Phila. Rd.	3 3/4	730	24	1947	...	21.4	...	1.8	4.8	1.3	1.9	..	31.2
St. Joseph	4 3/4	300	24	800	4.0	27.1	...	1.8	7.3	0.6	2.4	..	43.2
Berwick	3	402	24	1072	...	17.1	...	1.6	..	1.3	1.9	..	21.9
Nesquehoning	4	500	24	1333	...	23.6	...	2.3	4.0	1.2	2.5	..	33.6
Davis	5 1/4	731	7.5	689	9.6	30.0	...	2.8	..	2.2	4.0	..	48.6
Lincoln	3 3/4	867	24	2312	3.6	21.7	...	1.8	5.9	1.0	2.5	1.3	37.8
E. Canal	3 1/4	640	15	1067	0.6	6.4	19.2	2.5	..	2.1	2.5	..	33.3
Lehighton	5 3/4	3400	12	4533	2.5	32.0	...	2.8	..	2.0	2.8	1.0	43.1
Average					3.7	24.5	10.4	2.3	5.8	1.5	2.5	2.1	36.8

COST PER SQUARE YARD OF MACADAM WORK IN THE CITY OF EASTON, PA., FOR THE YEAR 1909.

Cost in Cents per square yard.

Street	Length, ft.	Width, ft.	Area, sq. yds.	Calculated Depth, in.	Crushed Limestone	Grading	Spreading Stone	Hauling and Breaking	Sprinkling	Rolling	Weighing Stone	Total Cost
Ferry (7th-8th)	438	30	1460	3.5	17.6	1.1	1.7	..	0.7	2.9	0.7	24.7
13th (Washington-Butler)	264	30	880	4.5	24.4	2.3	3.5	..	0.7	2.9	0.8	34.6
McCartney (Lafayette-Knox)	334	30	1113	6.5	35.4	3.0	3.1	..	1.4	3.6	1.2	47.7
Berwick (Seitz av. east)	384	9.5	405	6.0	32.4	15.2	2.8	..	1.5	4.6	1.4	57.9
Berwick (Reynolds-Centre)	360	24	960	3.0	16.0	2.0	1.8	..	1.4	2.7	0.7	24.6
St. Joseph (Charles-Phil. rd.)	360	24	960	4.0	20.4	0.8	2.6	..	1.7	1.9	0.9	28.3
Nequehoning (St. John-Davis)	650	24	1733	4.0	22.1	1.9	1.7	..	1.6	2.7	0.8	30.8
Valley Ave. (Bird-Milton)	160	24	427	3.5	18.1	4.3	1.2	..	2.6	3.8	0.6	30.6
High (McCartney-Sullivan)	388	30	1293	5.5	30.7	5.9	2.3	8.7	1.7	3.4	1.4	54.1
Reeder (Pierce-Monroe)	344	30	1147	3.25	17.1	4.0	1.9	8.2	0.6	3.0	..	34.8
Pine (11th-Peach)	1167	9	1167	4.0	21.8	..	2.1	4.6	1.4	2.4	0.7	33.0
Pearl (7th-8th)	331	16	588	4.75	25.4	..	2.4	6.1	1.8	5.5	0.8	42.0
Warren (Northampton-Sp. Garden)	662	16	1177	4.0	21.5	2.9	2.3	..	0.9	1.8	0.5	29.9
Lincoln (Parker east)	350	24	933	4.75	25.7	11.2	2.0	1.9	0.5	2.7	0.7	44.7
Ann	412	24	1098	2.75	14.8	..	1.2	..	1.1	2.9	..	20.0
Average												35.6

COST PER SQUARE YARD OF REPAIRS TO MACADAM WORK IN THE CITY OF EASTON, PA.

Cost in Cents per Square Yard.

Street.	Length, ft.	Width, ft.	Area, sq. yds.	Calculated depth.	Grading	Crushed Limestone	Spreading stone.	Crushed trap rock.	Sprinkling.	Rolling.	Drain pipe.	Weighing stone.	Total cost.
For the Year 1906—													
Chestnut	1200	20	2667	2 1/2	..	..	1.8	19.4	0.8	2.5	..	..	24.5
Front	800	25	2222	1 1/2	3.0	3.5	1.3	5.1	0.3	1.5	..	..	14.7
Fourth	770	25	2139	2 1/4	..	6.6	1.1	5.3	0.9	1.3	..	..	15.2
Bushkill	480	30	1600	1	2.8	..	..	7.4	..	1.3	..	..	11.5
Sitgreaves	950	9	950	2	..	..	0.7	15.1	0.4	1.3	1.4	..	18.9
Wood (12th-13th)	450	30	1500	2 3/4	..	12.9	1.2	..	0.5	1.3	..	..	15.9
E. Canal	1400	12	1867	2 1/2	..	19.9	1.8	..	0.4	1.1	..	..	23.2
Line	745	12	993	2 1/4	3.7	10.5	2.6	..	0.6	1.7	..	..	19.1
Average													17.9
For the Year 1907—													
Old Phila. Road	1400	15	2334	2 1/4	2.5	10.9	1.1	..	0.8	0.6	..	..	15.9
For the Year 1909—													
N. 3rd	760	44	3716	1 1/2	1.2	3.6	0.8	7.9	0.7	1.1	..	0.4	15.7
Front	480	30	1600	2 1/4	1.1	11.8	0.9	..	1.0	1.8	..	0.4	17.0
S. Del. R. Rd.	1383	16	2458	2 1/2	..	14.0	1.2	..	1.1	1.3	..	0.4	18.0
Average													16.9

PRICES PAID FOR MATERIAL AND LABOR ON MACADAM ROAD WORK, EASTON, PA., 1906-1909.

Year.	Crushed Limestone per 2000 lbs. del. on sts.	Crushed Trap rock per 2000 lbs. del on sts.	Foreman per hour.	Labor per hour.	Road Roller Engineer per hr.	Team per hour.	Carts per hour.
1906	$0.85	$1.50	20c	15c	25c	40c	25c
1907	0.90	1.58	30c	20c	30c	50c	30c
1908	1.05	1.65	30c	20c	30c	50c	30c
1909	1.02	1.58	30c	20c	30c	50c	30c

Creosoted Wood Block Pavements in Boston

By James H. Sullivan, Engineer Public Works Department, Boston, Mass.

The chief points for consideration in the paving question are to secure a pavement that is not affected by changes of the weather or variations in temperature; that is durable, reasonable in price from the standpoint of total cost; that is sanitary and easily cleaned; that gives least resistance to traction; that affords greatest security to traffic, in the elimination as far as possible of accidents caused by uneven, defective or slippery pavements. Opinion differs somewhat as to the relative importance of these considerations.

Several American cities have conducted some expensive experiments in paving problems and some of the most eminent authorities, both at home and abroad, have, after careful investigation and extended comparisons, expressed their firm conviction that, from all considerations, there is no pavement now laid that equals the creosoted wood block pavements. There are many reports of tests and investigations by competent engineers and experts showing the durability of creosoted wood blocks pavements to exceed that of any other paving material.

Boston was the pioneer in wood block paving in the eastern states, the first treated wood block pavement being laid in 1900 in Tremont street. Since then more or less of it has been laid each year. The greater part of the pavement is laid with long-leaf yellow pine, which gives the best and most durable pavement. A few streets were laid with treated black gum, but from a want of knowledge as to the method of treatment or seasoning the block this black gum is not wearing well, consequently we are confining our specifications to hard long-leaf yellow pine.

I consider a treated long-leaf yellow pine block suitable for any traffic. Blocks that have been under wear for thirteen years are apparently as serviceable as ever. Some of these blocks were taken up a few years ago as a matter of curiosity to determine how the traffic did affect them, and while we might say the block was possibly one-fourth inch less than the original four inches in depth, it is difficult to say whether that one-quarter inch was due to wear or to compression due to impact; this in a street where the vehicular traffic averages about 9,000 per day of ten hours. We are contracting this season for about 40,000 more square yards of long-leaf yellow pine wood block paving. The maintenance of our wood block paving has not cost the contractors or the city anything during the past twelve years, nor do we look for any outlay in the immediate future, judging from present conditions.

CREOSOTED *wood block pavement in Boston, Beacon Street, near Bay State Road.*

Following is list of streets paved with creosoted wood block, January 13, 1913, totaling 71,611 square yards, in the city of Boston proper, 19,698 square yards in Roxbury, 1,981 square yards in South Boston, 21,231 square yards in Dorchester, or 114,521 square yards in all:

WOOD BLOCK PAVEMENT IN BOSTON.

Street	Limits	Length in feet	Area sq. yds.	Year laid
	City Proper.			
Atlantic avenue	811 feet south of Kneeland street to 1,263 feet south of Kneeland street (bridge)	452	1,996	1906
Avery street	at Washington street (crosswalk)	12	8	1906
Avon street	at Washington street (crosswalk)	9	20	1906
Batterymarch street	at Milk street north and south sides (crosswalks)	14	42	1911
Beacon street	Massachusetts avenue to Raleigh street	1,527	8,145	1901
Boylston street	Boylston Place across Charles street	433	1,690	1901
Chandler street	Berkeley street to Castle square	504	2,216	1912
Charles street	at Boylston street	30	243	1901
Church street	at Boylston street (crosswalk)	13	45	1908
Church street	Fayette street to Melrose street	175	521	1911
Cortes street	at Ferdinand street (crosswalk)	8	20	1911
Eliot street	east side Pleasant street to Columbia avenue	163	800	1907
Fayette street	Pleasant street to Ferdinand street	856	1,948	1911
Ferdinand street	B. & A. railroad bridge to Isabella street	376	1,069	1911
Hammond street	Shawmut avenue to Tremont street	1,115	4,214	1912
Harvard bridge	Boston side of draw to 270 feet west of southerly abutment (plank base)	708	3,663	1912
Harvard bridge	270 feet west of southerly abutment to southerly abutment (plank base)	270	1,411	1912
Harvard street	Washington street to Harrison avenue	408	861	1910
Hayward Place	Washington street to 9 feet easterly (crosswalk)	9	20	1906
Isabella street	at Ferdinand street (crosswalk)	8	20	1911
Kilby street	at Milk street (crosswalk)	6	70	1910
Malcolm street	Pinckney to Mt. Vernon street	312	244	1912
Massachusetts avenue	Albany street to Harrison avenue (northerly roadway)	...	1,899	1912
Massachusetts avenue	Harrison avenue to Washington street (northerly roadway)	...	2,009	1912
Massachusetts avenue	Washington street to Shawmut avenue avenue (norherly roadway)	...	1,003	1912
Massachusetts avenue	Shawmut avenue to Tremont street (northerly roadway)	...	2,889	1912
Melrose street	Pleasant street to Ferdinand street	743	1,901	1911
Milk street	Pleasant street across Oliver street	300	1,156	1910
Milk street	Oliver street to Broad street	279	1,045	1911
Newbury street	Fairfield street to 205 feet east of Hereford	750	3,000	1901
Northampton street	Tremont street to Shawmut avenue	894	3,370	1911
Oliver street	Milk street to 152 feet southerly	152	591	1910
Park square	Boylston street across Eliot street	482	4,100	1907
Pearl street	Milk street to 153 feet southerly	153	508	1910
Pleasant street	Eliot street to Park square	93	425	1907
Providence street	74 feet east of Church street to Park square	151	1,400	1912
Public alley No. 442	between Newbury street and Boylston street from Gloucester street to 110 feet east of Gloucester street	110	98	1901
State street	Washington street to Devonshire street	115	530	1908
Summer street	Washington street to Hawley street	234	990	1908
Tremont street	23 feet north of Beacon street to 21 feet south of Beacon street	65	231	1900
Tremont street	18 feet north of Park street to southerly street line of Temple Place (on the westerly side)	...	1,064	1900
Washington street	Milk street to Beach street	2,279	8,660	1906
Washington street	Cornhill street to 78 feet south of Court ave.	509	1,475	1908
Washington street	south side of Milk street to 78 feet south of Court avenue	538	1,860	1907
Water street	Devonshire street to Congress street	213	956	1907
West street	Washington street to Tremont street	463	1,126	1908
Whitmore street	at Harvard street (crosswalk)	6	10	1910
	South Boston.			
Boston street	Ralston street to N. Y., N. H. & H. R. Ry. bridge	193	531	1911
E. Fourth street	P street to 97 feet west of Farragut road	426	1,450	1911
	Roxbury.			
Dudley street	Guild row across Harrison avenue	841	4,134	1912
Falmouth street	Norway street to Massachusetts avenue	634	2,433	1909
Guild row	42 feet north of Dudley street to Dudley street	42	257	1912
Harrison avenue	at Dudley street (crosswalk)	16	72	1912
Massachusetts avenue	bridge over B. & A. railroad	75	500	1908
Newbury street	205 feet east of Hereford street to Hereford st.	205	820	1901
Newbury street	easterly side of Hereford street to Mass. ave.	705	2,820	1903
Norway street	Falmouth street to St. Paul street	307	917	1909
St. Paul street	Falmouth street to Norway street	299	777	1909
Warren street	at Washington street (crosswalk)	10	73	1911
Warren street	at Dudley street (crosswalk)	23	216	1912
Washington street	Williams st. to 27 feet north of Marvin st.	1,026	4,779	1911
Washington street	Zeigler street to Dudley street	186	745	1911
Washington street	130 feet south of Dudley street to Dudley st.	150	1,035	1912
Westminster street	at Hammond street (crosswalk)	23	120	1912
	Dorchester.			
Bowdoin street	east sde of Quincy street to 78 feet west of Mt. Ida road	386	1,885	1909
Washington street	Moultrie street to Center street	182	850	1907
Washington street	Blue Hill avenue across Bowdoin street	4,115	18,496	1912

Our experience with creosoted wood block paving has been most pleasing to all concerned. The fact that the pavement on Tremont street, which has been in service for twelve years, has cost absolutely nothing for repairs, influences our opinion that creosoted wood block pavements are economical in every sense of the word for both heavy and light traffic streets.

Our experience, however, is akin to other large municipalities. In the borough of Brooklyn, New York City, the first creosoted wood block pavement was laid in 1902, without any guarantee, and has cost absolutely nothing for repairs. Pavements that were laid later and have been out of guarantee from three to four years, have been kept in repair by the borough and an accurate record kept of their cost. Some of the streets have cost absolutely nothing, and the average cost for the entire area out of guarantee has been 1 1-20 cents per yard per year. Many of these pavements, however, have been opened for sub-surface work, and the engineer in charge of pavements states that, in his opinion, practically all of the repairs are due to settlements over trenches, and damage caused by fires, and not to actual wear and tear of traffic. The borough of Manhattan, New York City, has three streets which have been out of guarantee three years, one of heavy traffic, one of medium traffic and one of light traffic. The heavy traffic street has cost 7 cents per yard per year, while the average of all has been 8 cents per yard per year; but it should be explained here, as in the case of the Brooklyn streets, that the repairs have been due to wear and tear only on the heavy traffic street, which is a wholesale street in the business section. Repairs on the other streets are due to settlements over trenches, damage caused by fire, and practically nothing to wear and tear of traffic.

Narrow Concrete Pavement for Country Roads

Under the new state aid law in Minnesota, Winona county has built a number of miles of narrow concrete road with macadam wings, the success of which will be watched with much interest.

The road consists of a strip of concrete in the middle, 8 feet wide and 6 inches thick, with a crown of 1 inch. On each side is a strip of macadam, rolled, of 2½-inch stone, which is 6 inches deep at the concrete, 4 inches deep at 4 feet out and tapers to nothing at 6 feet out. The total width is therefore 20 feet of which about 16 feet is valuable for travel, the outer 2 feet on each side being only a crushed rock shoulder.

The weak spot in the road is the junction between the concrete and macadam. If the macadam is too high it causes the water to get under the concrete and cracks it and if the macadam is too low the wheels drop off the concrete and cause the macadam to ravel and form holes.

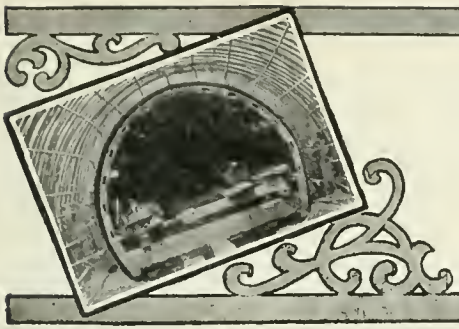
An observer of the Cuyahoga county, Ohio, roads would suggest putting the macadam all on one side so that there would be less turning off of the concrete and so that the horse traffic could keep to the macadam road when it desired, which seems to be most of the time. However the concrete road is not slippery, even on 7 per cent. grade, except on a few days of sleety weather.

The concrete costs about 90 cents a linear foot of the road, the macadam, 25 cents, and the grading including culverts about $1,500 a mile. Sixteen miles of road have cost $116,000. Hauling of wagon trains by tractor proved to be economical. Cement was hauled an average of 6 miles at about 20 a barrel. Gravel and sand cost about 20 cents a yard per mile for hauling, but under the most favorable conditions the cost was less than 6 cents a yard per mile.

Better Surfaces for Main Highways

The demand for better types of construction for the main highways thru the states is becoming stronger each year. New York state investigations show the necessity of durable surfaces such as brick or concrete. The state engineer of Illinois recommends brick or concrete for the state aid main roads. A concrete road is almost to the construction stage between Chattanooga and Knoxville, Tenn. It is demanded that as much as possible of the Lincoln highway be built of concrete. These facts show that the widespread demand from all sorts of country for the best road construction.

Some of the reasons for this are shown in the following comparisons of amounts of traffic: Thus France has one automobile to each 520 people and to nearly 5 miles of road. The United States has one for every 87 people and for a little more than 2 miles of road, while New York has an automobile for every 85 people and for every ¾ mile of road. The tendency of automobilists and automobile trucks toward increase of traffic on country roads is becoming more pronounced each year and the demand for adequate road surfaces must be met in other states than New York and Ohio and the few others which are attempting to meet that demand.



SANITATION

Cleaning Capital Streets

By J. W. Paxton, Supt. of Street Cleaning, Washington, D. C.

Previous to July 1, 1911, street cleaning in Washington, D. C., was done by contract under the direction of this division, but paid for from the appropriation for the maintenance of each building in proportion to the quantity removed.

Thruout the past year the following work was done under the immediate direction of this division:

Machine Cleaning—The cleaning of all paved streets outside the white-wing area every two days. On July 1, when this work was taken over from the contractor, the area cleaned amounted to about 2,500,000 square yards. During the year transfers were made in favor of white-wing work, reducing this area to about 2,167,000 square yards.

Alley Cleaning—The cleaning of all paved alleys in the District of Columbia about once every week. Additional alleys have been paved and added to those previously cleaned, bringing the total area cleaned from 985,000 square yards on July 1, 1911, to 1,033,000 square yards on July 1, 1912.

Suburban Cleaning—The cleaning of all macadam, gravel and unpaved streets not taken care of by the county, about once every ten days. During the past year additional territory was taken from the division of county roads and the total area increased from 905,000 square yards to 1,416,480 square yards.

Hand Patrol—The daily cleaning of all streets in the central portion of the city, amounting to about 2,005,000 square yards up to April 1, on which date this area was increased by 398,000 square yards and on May 1 still further added to, the present area being 2,745,804 square yards.

Flushing—The flushing of cobble stone, granite, asphalt block and poorly paved streets in the white-wing section of the city, amounting to about 300,000 square yards, washed about twice weekly.

Squeegeeing—The squeegeeing of nearly all of the smoothly paved streets in the white-wing area two or three times each week. Up to April 1 the area squeegeed amounted to about 1,368,000 square yards. Additional territory was added on this date, bringing the total up to about 1,766,000 square yards.

Dust Prevention—The sprinkling during the summer and fall of 1911 of about 60 to 70 miles of macadam gravel, and unpaved suburban streets. No sprinkling was done during the spring of 1912. The oiling during the spring of 1912 of practically all the suburban territory, the entire area being covered about six times.

Unit costs have steadily decreased thruout the year and the averages are considerably lower than the cost of the contract work prior to June 30, 1911. In addition to the greater economy, it is believed that the work has been of a higher quality and the streets and alleys have been kept cleaner. The success of municipal street cleaning is attributed largely to the fact that it is much more flexible than the contract system.

Under the old method of machine and alley cleaning every street and every portion of each street received the same amount of sweeping and the same price paid for each thousand square yards swept, whereas under the present system more effort can be put on the streets and on the portions of each street which have the most traffic and therefore tend to be more dirty. Under the contract system, the schedules were arranged for each day's work and that amount performed each day whether it required a full day's work or not. Under the present system continuous schedules have been arranged so that each foreman and his gang clean as much area as is possible in the eight hours constituting a day's work and commence again the next morning where they left off the night before.

Experiments during the previous year in street washing by squeegee and flushing machines proved so successful that

this method has been permanently adopted and the work will be extended as funds are available. The squeegee machines are operated in batteries of one sprinkler and three squeegees, the sprinkler operated some distance ahead to allow the dirt which has become baked and stuck to the pavement to be softened by the absorption of water and easily dislodged by the squeegees. With one battery, which works in the hilly section of the city, it has been found necessary to use three horses on each squeegee machine. Four additional squeegee machines have been purchased during the year, making a total of eight. Two flushing machines have been purchasing during the year, making a total of four. It has been the endeavor to cover nearly all the hand-patrol area two or three times a week with these washing machines, and in order to do this it has been necessary to work some of the machines on a double shift. By this system of street washing it is found that the streets are almost entirely free from dust. Any dirt which may accumulate does not have time to be pulverized and the particles are too heavy to be disturbed or blown about by an ordinary wind. Under the old method of cleaning these heavier and coarser particles were removed, but most of the dust remained to become a source of annoyance when disturbed by the wind or rapidly passing vehicles, altho the streets appeared to be clean.

amount on hand, and when and where issued, the index totaling about 1,600 cards. Another important feature of this card system is the establishment of maximum and minimum limits for each kind of stores, thus preventing any overstocking or shortages as stock is automatically purchased when the minimum limit is reached. Other advantages are the location of stock, all stock correctly priced, no stock lost, a check on supplies ordered, exact records of stock used and where used, and a perpetual inventory of stock always an hand and up to date.

No change has been made in the methods of keeping time for per diem employes, but the time book is now checked with the cost-keeping account, which eliminates possible errors.

Before being issued, the schedules of streets to be cleaned are platted on celluloid sheets mounted over maps and very carefully studied to prevent any dead travel. The areas of all streets cleaned have been accurately determined from the records of the surface division. Schedules are changed only upon order of the superintendent or assistant superintendent, and foreman allowed to clean only the streets on their respective schedules. Reports of the cleaned streets are sent into the office daily, and the areas computed.

The following records may prove of interest to readers of MUNICIPAL ENGINEERING:

	1911. Sq. Yds. Cleaned.	1911. Total Cost.	1911. Cost per 1,000 Sq. Yds.	1912. Sq. Yds. Cleaned.	1912. TOTAL COST.	1912. Cost per 1,000 Sq. Yds.
Hand patrol....	536,897,423	$94,134.48	$0.1753	646,377,000	$98,132.85	$0.152
Mach. sweep'g..	367,242,484	83,547.67	.2275	337,990,000	54,623.72	.162
Alley cleaning...	38,396,138	15,358.44	.40	54,664,000	17,752.45	.324
Suburban sts....	40,194,274	17,006.26	.....	27,825,000	14,559.76	.....
Squeegee	50,012,859	5,814.57	.1162	98,328,000	9,407.58	.096
Flushing	5,589,367	1,765.12	.3157	8,747,000	2,385.84	.272

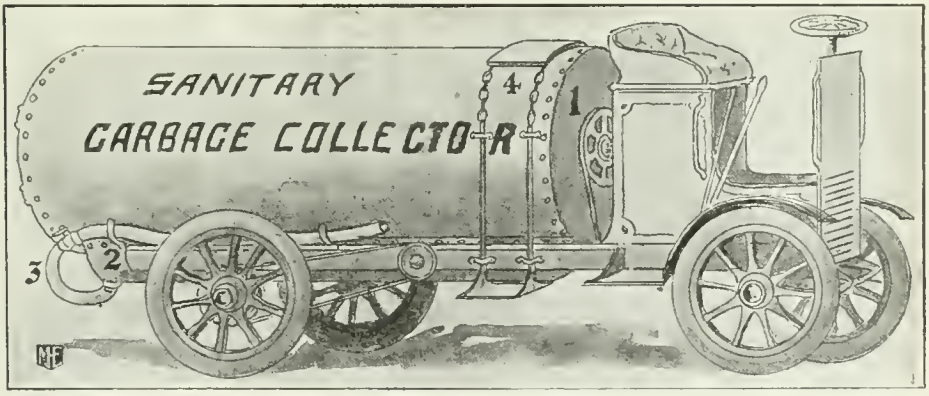
During the past year a cost-keeping system has been developed with the idea of attaining, thru the study of comparative costs, greater efficiency and economy. This necessitated among other things the establishment of a modern method of store-keeping and the systematizing of methods of street cleaning.

Under the present system of store-keeping, nothing is issued from the store-room without a signed order from the foreman or assistant foreman and only enough supplies for the job then under way are issued at one time. The record of supplies on hand is kept on index cards, one card for each item, and shows the price, contractor, when ordered,

Motor Trucks for Removal of Garbage

A western inventor, W. G. Sharp, of San Diego, presents the latest solution of the garbage disposal problem. It involves the use of a motor truck which carries a cylindrical container, and a device operated by the engine for compressing the garbage, extracting the liquid which forms the greater part of the weight and running the same off into the nearest sewer by means of a hose. This obviates the haulage of a large per cent. of the garbage weight and moreover delivers it to the incinerator in a dry condition that saves fuel.

The plan is to build the body of the car of steel in a cylindrical form. Inside of this cylinder, running the full length, is a screw (two or three screws could be used of desired). On this screw is a compressor plate. This screw is revolved with power applied to the forward end, which extends beyond the cylinder far enough to provide for the gearing. Revolving the screw moves the plate, which compresses the contents when driven toward the rear of the wagon, and it is moved back to position by reversing the power. When not compressing, the plate is kept at the front of the cylinder. Garbage is loaded to the truck thru one opening, well up toward the front. The door to the opening is opened by foot levers which give the operator free use of both hands in handling the buckets. It is closed by a spring, so that contents



MOTOR GARBAGE TRUCK *which has a compressor to squeeze out liquids and dumps them into the nearest sewer.*

are never exposed to the air more than a few seconds when actually dumping the buckets. When the car is reasonably full the garbage is compressed. This forces off the liquid, which runs to a separate compartment at the base of the cylinder; to this compartment is attached a long hose, the outer end of which is hung over the rear of the car, and it is closed by a stopcock. When the compartment is full the liquid is run off thru the hose, which is inserted to the base of any sewer or manhole where the wagon happens to be. The garbage will not have to be compressed more than two or three times on a trip, probably, and the liquid run off two or three times. This will depend upon how dry the operator wants to compress the garbage, and the capacity of the chamber which receives the liquir. Garbage will average over 70 per cent. moisture. With a minimum amount of compressing the capacity of a car can be doubled. Auto trucks, tho, will give all the power necessary for compressing, and it may be desirable to compress to the limit. If so, these wagons may perhaps carry three times the load. This is figuring bodies the same size of those now in use, but motor power wagons will probably be built with bodies two or three times the size of those in use now, so that the garbage carrying capacity of a motor power truck with this patent will probably be five or six times that of those now in use, and the work will be done in a sanitary manner. A crew of four or five men could go with each truck, if desired, and it can be kept on the move. Compressing in this way will reduce the odor, as a large percentage of this is in the liquid extracted and, the wagon being water-tight, very little odor will escape from the load.

The unloading feature is simple. The rear end of the cylinder is a hinged door forced tight against a rubber gasket with thrust bolts which may be easily manipulated. At the unloading station this rear door is opened, power is applied to the screw, and the compressing plate scrapes the whole wagon clean. A large hose will then be played into the cylinder and in that way it is kept clean.

Lighting

Municipal Electric Light for Cleveland, Ohio.

For some time the city of Cleveland, Ohio, has been operating two small electric light plants to which it fell heir when the towns in which they had been established were annexed to the city.

One of these, called the Brooklyn plant; has a rated capacity of 1,500 k.w., and the other, the Collinwood lighting plant, of 430 k.w.

The question of the construction and operation of a municipal plant for lighting the whole city has been under consideration for some time and a large plant of 15,000 k.w. capacity is now under construction.

These two smaller plants have been operated to some extent to demonstrate the possibilities of the larger plant. The following results of the operation of the plants taken from the 1912 audit of the books of the department, recently concluded, will therefore be of interest as a means of comparison. The figures for expense in both plants include allowances for interest paid to sinking fund trustees and for depreciation, but the amount of these allowances is not stated.

SUMMARY OF 1912 ACCOUNTS OF TWO MUNICIPAL LIGHTING PLANTS OF CLEVELAND, OHIO.

Property Statement.

	Brooklyn.	*Collinwood.*
Rated capacity, kw.....	1,500	430
Bonded indebtedness....	$30,000	$40,000

	Both Plants.
Total bonds 1900-1902	$70,000.00
Added from earnings to plant value 1900 to 1912	518,930.08
Book value of plants December 31, 1912	$588,930.08
Depreciation to Dec. 31, 1912..	133,552.49
Present value of municipal light plants	$455,377.59

Revenue Statement.

	Brooklyn.	*Collinwood.*
Revenue	$140,313.62	$36,590.48
Expense	93,147.82	34,425.85
Profit	$47,165.80	$2,164.63
Additions to plant value, 1912 ..	$69,466.01	$8,143.65

	Both Plants.
Total added to plant value, 1912	$77,609.66
Cash balance on hand, Dec. 31, 1912	20,834.08

Statement of Product and Unit Prices.

Generated in 1912 kw.....	5,550,384	
Sold in 1912 k.w.....	4,488,917	
Average sale price	3.49c	4.30c
Average cost price	2.92c	3.61c
Average profit	0.56c	0.68c

The equipment of the plants is as follows:

Brooklyn:

Two 250-h.p. water-tube boilers.
Two 350-h.p. water-tube boilers.
One 1,333-k.v.a. turbine.
One 500-k.w. turbine.

Collinwood:

Three 125-h.p. fire-tube boilers.
One 175-h.p. fire-tube boilers.
One 350-h.p. Corliss engine.
One 150-h.p. Corliss engine.

In anticipation of the completion of the new plant in the fall a bulletin has been issued giving announcement of a new rate schedule and showing a chart outline of the new rates for both large and small consumers. These rates are as follows:

Schedule No. 1. For resident and business purposes:

No payment shall be less than 60 cents per month.

The first 10 units at 8 cents per unit.
The next 690 units at 5 cents per unit.
All over 700 units at 3 cents per unit.

Schedule No. 2. For picture shows and theaters using over $25.00 per month:

No payment shall be less than $25.00 per month.

The first 500 units or less at $25.00.

All over 500 units at 3¼ cents per unit.

Schedule No. 3. For power; a monthly service rate as follows:

For Three-Phase Current.

Horse Power Rating.

For first 50 h.p. or less 75c per h.p.
For next 50 h.p. or less 60c per h.p.
For next 100 h.p. or less 50c per h.p.
For over 200 h.p. 40c per h.p.

Equivalent Kilowatt Rating.

For first 37½ k.w. $1.00 per k.w.
For next 37½ k.w. or less 80c per k.w.
For next 75 k.w. or less 60 2/3c per k.w.
For over 150 k.w. 53½c per k.w.

No demand charge to be less than $1.50 per month.

For Single-Phase Current.

For all h.p. at 50c per h.p.
For all k.w. at 66 2/3c per k.w.

No demand charge to be less than 50c per month.

Monthly Rate for Current Consumed.

(In addition to the monthly service charge.)

For the first 500 units or less at 3¼c per unit.

For the next 500 units or less at 3c per unit.

For the next 1,000 units or less at 2½c per unit.

For the next 1,000 units or less at 2c per unit.

For the next 1,000 units or less at 1½c per unit.

For all over 4,000 units at 1c per unit.

For Small Horse Power Users.

(With no service or demand charge.)

For 2 h.p. or less, 3 phase, a minimum charge of $1.50 per month.

For each additional h.p. 3 phase, a minimum charge of 75c per month.

For each 1 h.p. or less, single phase, a minimum charge of 50c per month.

For each additional h.p., single phase, a minimum charge of 50c per month.

For all current consumed in excess of this monthly charge, at the rate of 5c per unit.

Under these rates no one will pay more than 3c per k.w.-hour for electrical energy nor will any one receive service for less than 1c per k.w.-hour.

Rates lower than 3c per k.w.-hour will be based upon the capacity of the service connection and upon the amount consumed during any one month. No so-called "flat" rates for less than 3c per k.w.-hour will be granted. The rate which any consumer will pay for current will, if the consumption is large enough, vary from month to month from 3c down to 1c, decreasing with both the size of the connection and the amount used.

How the rates are figured on a sliding scale of consumption.

Thus, if the customer has a 200 k.w. service connection and he uses 20,000 k.w. hours in any one month, his rate will be based upon an average use of his full connected capacity for 100 hours and his rate will therefore be for that month 1.6 cents. If, however, he uses 50,000 k.w. hours in one month his rate will be based upon an average use of his full connected capacity for 250 hours and his rate will accordingly be 1c. This is found on the chart by taking the intersection of the horizontal line from the 200 k.w. service connection with the vertical line representing the average hours used and from this intersection following the diagonal line upward to the right hand side of the chart. Where this diagonal crosses the edge of the chart will be found the figures which represent the rate to be paid.

If the number representing the average hours used is found at the bottom of the chart, then the diagonal must be followed downward instead of upward to find the rate.

The chart represents the rate schedule for a five-year contract. For a one-year contract 10 per cent. must be added to the rates for a five-year contract. Provided, however, that no rate will be over 3c per k.w.-hour.

A minimum guarantee will be required in all contracts of 75c per month for each k.w. capacity of the service connection, but this is not to be added to the bill, it is only a guarantee that the monthly consumption shall equal this amount, and no bill for light or power will be less than 75c per month.

Any one having a five-year contract can discontinue service at any time after one year by the payment of an amount to be determined by adding 10 per cent. to his first year's bills, 7½ per cent. to his second year's bills; 5 per cent. to his third year's bills, and 2½ per cent. to his fourth year's bills.

All contracts for less than one year are upon the same conditions as one-year contracts, except that in addition thereto the consumer pays the cost of the service connection, and any one having contracts for one year or longer may discontinue the use of current at any time within one year under the conditions above except that in addition thereto he must reimburse the city for the cost of the service connection.

The principal reason for the solicitation of power consumers, is that the day load of the plant may be increased; thereby increasing the total output of the plant beyond that possible from the lighting business alone, thus reducing the cost of production per unit.

Consumers having an "off peak" load which can be thrown off during the hours of greatest load on the plant will be given added inducements which will be announced later.

There is considerable capacity for a day load for power from the West Side plants and consumers whose plants can be reached by the present distribution system will be taken care of at once, up to the limit of the capacity of these plants. Others will be given service as fast as possible and those in the districts to be served will be connected in the order in which their applications are filed.

All service for 50 k.w. and over will immediately be given the rates indicated by the chart. Smaller consumers will be given the benefit of these rates as soon as operation at the large new plant at East 53rd Street is started.

Municipal Profits from Gas and Electricity

The gas department of the Bradford Corporation during the financial year ended March 31 last made a net profit on the year's working of $96,089, as compared with $46,806 in the preceding twelve months. The profit was higher than in auy year since the purchase of the gas works in the districts incorporated when the city boundaries were last extended. The income of the department last year amounted to $1,642,643, which was an increase of no less than $111,545. The chief items contributing to this result were $27,739 from increased sales of gas and $73,971 from the sales of residuals. Better markets were found for coke, tar, and other residuals.

Owing to the increased price of coal, the cost of manufacture of gas exceeded by about $48,665 the cost for the preceding year, while a new item of expenditure—iusurance act contributions—added $2,190 to the expenditures.

After transferring over $34,065 from revenue account toward the cost of the new vertical retorts at the Thornton Road works, there remained at the end of the year a credit balance of $141,464 unappropriated profits, of which $24,332 is to be used for reduction of taxes during the current year.

The net profit on the Bradford city electricity works for the year ended March 31 last was $41,253, an increase of $2,068 on the previous year. The income from the sale of electricity showed an increase of $43,648, and other sources of income made the total increase of $47,701. The cost of coal for generating purposes had increased by $24,111 and the total cost of generation was $170,911, which included $87,446 for coal, $37,389 for repairs and maintenance of plant, and $23,948 for distribution, representing repairs of mains, meters, fuses, etc. The gross profits were $324,805, as compared with $315,388 last year. Interest on loans and income tax consumed $105,185 and $178,367 was set aside to the sinking fund for paying all the debt, leaving, as already stated, a net profit of $41,253. The total number of units sold during the year was 24½ millions, as compared with 22 millions the previous year. Of the total 10½ millions were supplied to the tramways, at a charge of 2 cents per unit. The report also stated that, as compared with the total expenditure on the undertaking of $4,267,920, the outstanding debt was now only $2,444,842.

Municipal Gas Plant at Duluth, Minn.

The city of Duluth, Minn., is fortunate in that it is able to purchase its supply of gas from the Zenith Furnace Co., as a by-product of the method of producing coke for use in making steel. Thus the city simply distributes the gas supplied under a contract fixing its price and quality. The cost of gas is about 41 cents a thousand cubic feet, distribution costs about 11 cents and interest about 12 cents making a total cost of about 64 cents with a consumption of about 325 million cubic feet a year. The aggregate cost has diminished with the increase in consumption from $1.53 in 1899 when the plant was purchased.

When the city purchased the plant the rates to consumers were $1.90 for light and $1 for fuel. They were reduced each year until in October, 1905, they became 75 cents for both light and fuel with a further reduction in 1906 to 50 cents for gas used in heating of premises and in gas engines. These have been the rates until the present date.

The above figures do not include any allowance for depreciation, and the value of the plants is carried at its full cost. It is stated, however, that the surplus earnings of the plant have been expended in extensions and that these surplus earnings have been definitely shown to be much larger than a very liberal estimate for depreciation, so that there is really no deficiency in this regard but rather an excess. The new manager of the plant, S. R. Hatch, recommends a complete classified inventory and valua-

tion of the water and gas plants under his charge and the opening of proper property accounts so that the depreciation in assets and the accession of new assets may be shown clearly.

Mansfield, Mass., Lighting Plant

By George W. Wood, Manager.

The town of Mansfield, Mass., while making no appropriation for the maintenance or depreciation charges of the plant, which are charged to receipts from commercial business, annually includes in the tax levy the interest and bond requirements, which last year were $6,880. The apportionment of the above amount is as follows: Three thousand eight hundred and eighty dollars for interest on outstanding bonds, $1,000 for sinking fund on the $50,000 of thirty-year bonds, and $2,000 to retire two $1,000 serial bonds of the $52,500 serial bond issue. The total number of street lights, figured on a 40-watt basis of current consumed, is 580.

It will be seen by the above figures that all that can be properly charged to cost of street lighting is the amount the town expends for interest charges; viz., $3,880, the balance, $3,000, being the bond payment. The net profit of the plant from commercial business was $5,466.89.

The Massachusetts law relating to municipal lighting plants forbids the sale of current at less than cost, also that its net earnings shall not exceed 8 per cent. In accordance with the above facts, the board has prepared a new schedule of rates to the consumers, reducing the base rate from 15 cents per kw. to 13 cents per kw. and allowing a 10 per cent. discount in addition, on monthly bills, if paid on or before the 15th of the following month. The new schedule is based on current consumed only, and bears no relation to old or existing rates. This reduction applies only to current used for lighting purposes, and does not apply to power, for which a new schedule will also be adopted.

It has been the custom in past years for the town to accept the profit and loss balance, together with interest charges, as the cost of street lighting. It has also been the custom from time to time to add additional street lights, until at present the original installation has nearly doubled. It is still the cost of street lighting to the plant. From a financial showing the plant receives the same; namely, nothing. It is our opinion that the plant should be placed on a proper basis to give a correct financial statement of actual business transacted. To do this, it is necessary that the town should pay a fixed price for each street light installed; and the receipts of the plant should pay all bills, including interest, sinking fund payments and bond retirements.

If the town should pay for what would be the equivalent of 580 street lights, at the rate of $12.00 per light, the same being about one-half the rate charged for similar service elsewhere, the plant would be able to meet all charges, and at the same time make a liberal reduction in the rate to the consumer.

The apparatus consists of a Fort Wayne type QRC, 160-kw., 2-phase, 44-pole, 160-r.p.m., 60-cycle alternator. This generator is direct connected to a 220-h.p. Diesel engine. The alternator shaft has a special extension beyond the outer bearing on which is mounted the armature of a Fort Wayne type MPL, 6-pole, 15-kw., 120-volt direct current exciter; a special extension to the alternator base being provided for the support of the exciter field frame.

During 1911 the street lights were extended on Branch street in accordance with the vote of the town last March. There are now installed 390 40-watt, 32-c.p. lights and 31 250-watt, 200-c.p. lights. The commercial service was extended to East Mansfield. A sprinkler system has been installed thruout the office and basement of the main building. The income from light and power was $21,136.60, an increase of $1,973.82 over last year, or about 10 per cent.

The following data may be of interest:

	1911	1912
Customers	376	460
Meters installed	427	488
Transformers installed	63	69
Horsepower of motors installed	302	310
Street incandescent lights, 200-c.p., 250-watt	31	31
Street incandescent lights, 32-c.p., 40-watt	379	390
Line poles owned	396	447
Miles of street lines	69	75
Gallons of fuel oil used	60,865	66,217
Average price per gal.	$.0265	$.0416

The appraisal value of our plant is as follows:

Land	$ 2,000.00
Building	9,328.46
Engine plant	42,705.48
Electric plant	17,092.74
Electric lines	21,480.75
Transformers	4,973.40
Meters	4,809.20
Street lights	1,546.48
Total	$104,936.51

CONCRETE

Concrete Construction in Dalton, Ga., Water Works.

THE city of Dalton, Ga., recently completed a new water works and lighting system and the power, lighting and pumping plant is situated one and one-half miles from the center of the town on the edge of Mill creek. The data for this description and the photograph are supplied by John W. Ash, of Chattanooga, Tenn., the engineer for the work.

The pumping plant includes a low-head 8-inch motor-driven centrifugal pump, which lifts water from the creek to the coagulating basin and from this point the water passes by gravity thru the filters to the clear water well. From there it is pumped by a 7-inch high-head motor-driven centrifugal pump to the main reservoir on top of Mt. Rachel, which is nearly 300 feet above the creek level.

The power house, coagulating basin, filters, clear water well and reservoir are built of reinforced concrete, the bid for the power house if reinforced being less than the bid for brick construction. The floor area of the power house, including filter, covers about 4,650 square feet. The walls average a little over 20 feet in height, 6 and 8 inches thick, with columns averaging about 11 feet on centers. A beam 12 inches square runs around on top of all walls. The concrete mixture used was 1:2.5:5.

The coagulating basin is 40 feet inside diameter and 10 feet deep. The walls are 9 inches thick and bottom is 4 inches thick. The basin has four wooden baffle walls built of 2-inch plank and 4x6-inch posts. The concrete was mixed in the proportions of 1:2:4.

The clear water well is 40 feet inside diameter, 12 feet deep with 9-inch walls, 6-inch floor and a self-supporting concrete roof, having a rise of four feet at the center, where there is a 4-foot manhole with screen ventilator. The mixture of concrete used was 1:2:4.

The two filter tubs are 15 feet in diameter and 9 feet deep, with a concrete trough around the sides and thru the center. Each filter has six inches of gravel over the strainers, above which is about thirty inches of screened sand. The capacity of each filter is about 500,000 gallons in twenty-four hours. There were no special features pertaining to the basins or building.

All the materials were brought to the site on a spur track at one end of the building. The mixer was set up alongside the track, the hopper being placed about on a level with the top of a stone car, so that materials could be wheeled directly from the cars. But the material arrived so irregularly that 75 per cent. of it had to be unloaded on the ground and re-handled. The mixer was about at the same level as the top of the coagulating basin and lacked but a few feet of being as high as the highest walls of the power house, so that runways had to be elevated very slightly.

All the concrete was handled in wheelbarrows, the longest distance wheeled being to the clear water well and the coagulating basin, about 125 feet. The bulk of the concrete was wheeled about seventy-five feet.

The main reservoir is 80 feet in diameter, 21 feet deep and has 10-inch walls, with coping floor 6 inches thick. The footing course is 12 inches deep and 2 feet wide. Concrete was a 1:2:4 mixture.

The construction of the main reservoir, which is located on the top of a hill about 300 feet above the creek level, in-

volved some features a little out of the ordinary. There was no road to the top and to have built one would have required considerable time and money. The mixing plant was placed at the foot of the hill and the concrete and other materials were hauled to the top on a tramway. The stone, cement, sand and steel were hauled by wagons from a siding about ⅜ mile away, to which a road and bridges had to be built about one-third of the way. The total length of tramway was about 900 feet and as soon as the track had been laid about a third of the way a double-drum hoisting engine was placed on it and made to pull itself up to that point, where it was set off with the drums facing the track. A ½-inch wire rope was passed around a horizontal sheave in the center of the track, dragged to the top of the hill and passed around another vertical sheave and back again to the foot of the hill hooked to a flat-car which has the back end raised about 2 feet to conform to the average slope of the track.

CONCRETE RESERVOIR *of Dalton, Ga., water works, on top of Mt. Rachel.*

The materials were hauled to the workmen as the track progressed, the pulling line making a good center to work by. The engine was taken part way up the hill for the reason that the empty car returning would not have been heavy enough to unwind the line from the drum and return to the bottom without starting at the top at too dangerous a speed. The latter part of the ascent was at least twice as steep as the first part.

In order to make a trip in the minimum time it would be better to use two lines, a single line from the foot of the hill to the engine and the double line the balance of the way. After a few trips the men became so accustomed to it that they could make the change of couplings in 10 to 15 seconds.

There was ½-yard Smith mixer placed at one side of the track near the end, which was fed from the piles, which were placed far enough up the hill to make the wheeling nearly on a level with the hopper.

The water was procured by digging a large well about 300 feet below the mixer and was pumped into the mixer tank by a steam pump, driven by the same boiler that drove the mixer. The supply was insufficient and some water had to be hauled by wagon.

The concrete was carried in two concrete carts, each cart carrying one batch. While these were being hauled to the top and returned empty two more would be loaded and ready when the empties returned. At the top the landing platform was nearly on a level with the top of the reservoir walls, but as these walls were carried up in 7-foot sections, the concrete was dumped down a chute to a platform on a level with the top of the section, where it was rehandled with wheelbarrows.

As soon as the work of concreting was well started and each man knew just what he was to do, a round trip could be made very quickly. The best day's run was 74 trips in 8 hours, less than 7 minutes to a trip. The average, however, was about 9 minutes, owing to an occasional derailment or other slight delay.

As the top of the mountain is cone-shaped, about 1,650 cubic yards of excavation was necessary to make a site large enough for the reservoir. The excavation ranged in depth from 18 inches to 14 feet. Half of it was a compact clay and the balance loose and solid rock that required blasting.

The outside forms were built by setting 2 by 4-inch studding, spaced 2 feet apart on a template sawed to radius. The inside forms were built in sections 12 feet long and 7 feet high. They were made on the ground ready for setting up as soon as the steel had been placed high enough to receive them. Enough sections were made for two vertical runs.

When the first section had been filled and steel placed 7 feet higher, the next sections of forms were placed and wired; while these forms were being filled the bottom sections were loosened up and made ready for raising to the top. There was a gasoline saw rig used for sawing the inside ribs, jointing and ripping form lumber.

The Capitol Avenue Bridge

By L. V. Sheridan, C. E., Chief Inspector, Board of Park Commissioners, Indianapolis, Ind.

The Capitol avenue bridge, across Fall creek, is the latest of the many fine bridges possessed by the city of Indianapolis, to he erected. Its construction was commenced on June 19, 1911, and the last portion of its construction was completed the latter part of May, 1912. A bridge of permanent character, to replace the old steel truss already in place at this point, had long heen projected, and had even reached the point where plans had been prepared, hut various causes had interfered and the old structure still stood, an object both unsightly and dangerous. Late in 1910 the Board of Park Commissioners of the city and the Commissioners of Marion County joined hands in its construction, the agreement being that the county should stand $70,000 of its cost and the park board the remainder, which amounted to $30,000.

The conditions governing the design of this bridge were possibly more complicated than is usual. Capitol avenue is the north and south boulevard, connecting the center of the city with the extensive system of parkways planned along Fall creek. The greatest development has taken place at this point and the work is assuming that completed state where it is appreciated by all. It was therefore necessary that some results other than strength should be present. It should seem in harmony with its surroundings and at the same time have a dignity which would be impressive. Suitable curved approach walls were necessary to unite it with the parkway drives on either side of the stream and to destroy the feeling of abruptness occasioned by many bridges whose designers have paid little attention to the architectural features of the design.

The bridge consists of three seven-centered arches, the center one having a span of 84 feet and the end ones spans of 48 feet each. The center arch has a rise of 11 feet 6 inches, and the smaller ones rise of 8 feet 9 inches. Granite, quarried at Mt. Airy, North Carolina, is used for facing the piers and abutments up to the spring line and the first course of the approach walls. It is of a uniform gray color and harmonizes very well with the buff Bedford stone furnished by the Bedford Cut Stone Company, used for the facing above the spring line. The piers and abutments are surmounted by cast bronze cluster lamp standards of special design, and similar standards, slightly smaller, adorn the end posts of the approach walls. A slight camber carried over the structure gives an effect of solidity and completeness which is very pleasing.

The piers, 15 feet thick at the base, and the abutments, 21 feet thick, are carried on 15-foot piles, spaced 3 feet center to center, except in the south pier, in which 20-foot lengths were used. The concrete was mixed in the proportion of one part cement, three parts sand and five parts gravel. The gravel excavated from the foundations was found to be very satisfactory, with the exception of the presence of a slight excess of fine aggregate, which was remedied by the addition of coarse material purchased near by. The arch rings were mixed in the proportions of one part cement, two parts sand and four parts broken stone, and were poured in longitudinal sections. The first end arch to be cast was poured in one section, but as this necessitated working until late in the night, the other was cast in two sections and the center in four. The reinforcing in the arches was very heavy, consisting of sets of upper and lower longitudinal bars, shear bars and transverse bars, as shown in Figs. 2 and 3.

Among the interesting features of the construction was the contractor's plant, which, while embodying no unusual features, was very efficient. At the south end of the work a 60-ft. swing derrick was erected and at the north end a 70-ft., while resting on the center pier of the old steel bridge was an 80-foot. These were all operated with "hull wheels," permitting a swing of practically 360 degrees, and, when lowered, were close enough together for the load to be transferred from one to the other. Mixing plants were erected at each pier and abutment for pouring the lower courses. For the arches a large mixer was placed at the north end of the bridge, and the tracks leading to it were so arranged that the cars were loaded while in motion. The concrete in buckets was carried in cars over a trestle to the point where needed and placed with the aid of the derrick. The piles for both the false work and the foundations were driven with a No. 2 Vulcan steam hammer and were placed rapidly.

The cement used was required to pass the requirements of the American Society of Civil Engineers. A large number of tests were made, and the following are the results obtained:

NEAT TESTS.

Age.	No. tests,	Av. Lbs. pr. sq. in.
24 hours	30	251
7 days	22	540
28 days	13	496
2 months	3	450
3 months	3	840

ONE PART CEMENT—THREE PARTS SAND.

Age.	No. tests, Av.	Lbs. pr. sq. In.
7 days	13	153
28 days	9	223
2 months	3	352

With the exception of two cases, the results are above the requirements, and the low averages in these two cases were caused by the presence of a few damaged briquets, which broke at a small load. Tests for time of setting and the boiling test were performed on the work, and in all cases were up to standard.

The specifications called for the backs of all walls and the tops of arches to be "water-proofed with a mortar consisting of one part cement, three parts sand and the proper amount of Medusa water-proofing compound or its equal." This was used on one arch, but on the other two two coats of an asphaltic paint were painted on, and this was used to back some of the stone, but it gave very poor satisfaction. It had very little adhesive power, and, while it is apparently water-proof in itself, as proven by several tests, it failed to stick to the arches or stone work, and in consequence some leakage occurred. On some of the last walls put up the backs were plastered with mortar water-proofed with 4 per cent. of Medusa, and this has apparently held back all moisture. In consequence of this experience, the water-proofing clauses in the specifications for an arch now building for the department were revised and now call for the spandrel walls and approach walls to be water-proofed throughout with 4 per cent. of Medusa or its equal, and that a ring of the arch two feet thick next to the wall be water-proofed with the same amount. The result is awaited with interest.

The arch, as stated previously, was built jointly by Marion county and the Department of Public Works, and was designed by Mr. George E. Kessler, landscape architect for the Park Board. Mr. Robert C. Barnett had charge of the engineering features and Mr. H. C. Broadwell was the architect for Mr. Kessler. The Cleary-Kuert Company, of Indianapolis, were the contractors. The writer was in personal charge of the work during construction. Lehigh portland cement was used exclusively. The materials used were as follows:

5,520	barrels Lehigh portland cement.
117½	tons reinforcing steel.
960	tons Bedford cut stone.
485	tons Mt. Airy granite.
2,000	cubic yards crushed stone.
4,000	cubic yards sand and gravel.

Conservation of Road Building Funds by Proper Design and Repair

The Office of Public Roads of the Department of Agriculture is making a strong effort to focus the mind of the country on the fact that maintenance and effective repair are of equal importance with the actual improvement of bad roads. Investment of money in new roads does not become real economy until provision is made for keeping these new roads in condition after they are built. If a new road was built and then allowed to fall into disrepair, much of the original investment is simply wasted.

Europe, generally speaking, is ahead of the United States in the matter of road improvement, but Great Britain is struggling with a problem similar to the one that confronts the people of the United States. In England, Scotland and Wales there are no fewer than 2,140 separate authorities who, between them, administer 175,487 miles of roads, or an average of only 82 miles apiece. In Scotland, apart from the big cities, there are over 200 burghs, one-half of which have but 10 miles of road apiece to maintain. Needless to say, such a minute mileage is insufficient to keep the road plant fully occupied all the year around and renders the employment of a skilled engineer impossible for economical reasons.

Officials of the Office of Public Roads, when called upon for assistance by the various states, are pointing out that road building is an art based on a science, and that trained men and experienced men are necessary to secure the best results from the expenditure of road funds.

Statisticians have found that, although the average expenditure on the improvement of roads exceeds one million dollars a day, a large portion of the money in the United States is wasted because of the failure to build the right type of road to meet the local requirements or the failure to provide for the continued maintenance of the improvement.

The various states and counties within the past six months have taken a greater interest in road improvement than ever before in the history of the United States, and there is now a strong movement to conserve the roads of the country where they are improved. Scientific maintenance will be one of the chief features of the work of the Office of Public Roads throughout the present year.

MISCELLANEOUS

The New Home Rule Charter of Dayton, Ohio.

On August 12 the voters of the city of Dayton, Ohio, adopted the new charter which provides for a business manager to take charge of the administration of the city's affairs, to be appointed for his fitness for the work and by an elected commission.

The city of Staunton, Va., is probably the first city in this country to turn the operation of city departments over to a business manager. This was done in 1908, the mayor and the two-chambered city council creating the office and filling it. This was entirely voluntary and could be revoked at any time.

The idea has worked out so well, however, that, not to mention purchasing agents and other business agents for departments of city government, the general plan has spread rapidly.

In 1911 Lockport, N. Y., tried to get a charter which would permit the operation of the city by a business manager and failed. In 1912 the city of Sumter, S. C., under a new law in that state, adopted the commission form of government with a city manager, appointed by the commission and acting under it. The law and the charter are very meager in their provisions but the plan seems to be operating successfully. In 1913 the city of Hickory, N. C., adopted the same plan, the first city council under the new charter being elected in April. Westmount, a suburb of Montreal, Que., is also installing the office of general manager, the first one being appointed in May.

The states of New York, New Jersey and Wisconsin have been considering legislation on the same line and the State of Ohio has passed a law which contains the most advanced ideas regarding municipal government as yet crystallized into legislation. This law is based on a bill prepared by the Municipal Home Rule Committee of the Municipal Association of Cleveland and approved by the Ohio Municipal League, and presents three plans of city government from which cities can choose, preparing their own charters in conformity with the plan adopted. This law thus recognizes very fully the right of cities to rule themselves.

The three plans presented are the Commission plan with three or five commissioners having full charge of legislative and executive departments of the city; the City Manager plan, with five to nine councilmen, one of whom is mayor, having the legislative functions, who appoint a city manager, with full power over the administrative departments of the city government; and the Federal plan in which the elected city council has all the legislative power, and the elected mayor has the executive powers, with the elected municipal judges to exercise the judicial powers.

Des Moines, Sumter and Indianapolis may be taken as prominent representatives of the three plans, and to these are added the home rule principle as perhaps most definitely stated heretofore in the laws of Colorado, but permissible in Ohio under an article of its constitution.

Each city organizing under the new Ohio law is also given the duty of voting upon the adoption of the initiative, the referendum and the recall.

The city of Dayton was ready to take advantage of this law as soon as it went into effect. A charter commission was elected at a special election held May 20, 1913, and immediately presented a form of charter for public discussion, which was put into final form for submission to the voters on June 23. Meantime provisions of the statute regarding procedure in adopting this charter were met and the election for the adoption of the charter was set for August 12 and the system will be put in operation on January 1, 1914, under officers to be nominated September 2 and elected November 4.

Copies of the charter voted upon can probably be obtained of the Bureau of Municipal Research at its Dayton office, 601 Schwind building. A statement of

its most prominent features will be of interest here, omitting features common to all charters and those which are strictly local in their application.

Method of nominating Commissioners.

Candidates for commissioner are nominated by petition of at least 2 per cent. of the registered voters and acceptance by the candidate, the primary election to be held hereafter on the second Tuesday of August of each odd-numbered year. Names of candidates are arranged alphabetically and ballots are printed and put in blocks so that each candidate's name appears at the top the same number of times, the others ranging after him alphabetically around thru Z and A to his initial again. At the regular election, held on the Tuesday after the first Monday in November, the names of those receiving the highest number of votes, not more than twice the number of offices to be filled, appear on the ballots in similar orders to those at the primary. Two commissioners are elected regularly at one election and three at the next, the term of office being four years.

A commissioner may be recalled by an election called on a petition of 25 per cent. of the registered voters, and if recalled the vacancy is filled by the candidate receiving the largest number of votes at the same election, each candidate being required to file a nominating petition of 5 per cent. of the registered voters. The obnoxious official has six months in which to make good after any regular or recall election in which he is successful. The city manager can be recalled by petition and election altho he is appointed by the commission, as is his successor.

Ordinances may be presented to the commission on initiative petition of 10 per cent. of the voters and if the final action of the commission, to be taken within 30 days, is not satisfactory the ordinance must be submitted to the voters on petition of an additional 15 per cent. of them, or 25 per cent. in all, in the form set out in such petition. Proposed repeals on petition follow the same course. No ordinance but emergency ordinances, which are fully defined, can go into effect until 30 days after passage, so that a petition can be filed, if desired, demanding its repeal or submission to the voters. If two or more ordinances submitted to an election are conflicting, the one receiving the highest number of votes is declared adopted and the other is not, even if it receives a majority of the votes cast on it. Emergency ordinances are subject to the referendum but are in operation meantime.

The commissioner receiving the highest vote when three are elected is the mayor for the ensuing four years, the other three members of the commission deciding in case of a tie. The position is largely honorary beyond his duties as a commissioner. He receives $1,800 a year and the other commissioners $1,200. They are docked 1 per cent. of their annual salaries for absence from regular meetings without authorization and a seat is vacated by 5 consecutive unexcused absences. The commission fixes the dates of regular meetings, which must be held at least once each week.

The commission chooses its clerk and other direct employes, and the city manager. It must provide for continuous audit of books of administrative departments and regular statements of condition of accounts, summaries of receipts and expenditures, etc., to be printed and distributed as prescribed.

The City Manager can be a non-resident.

The city manager may be a non-resident when appointed, his political beliefs must not be considered, and he holds his office at the pleasure of the commission or the recall. His duties are

(a) To see that the laws and ordinances are enforced.

(b) To appoint and, except as specifically provided, remove all directors of departments and all subordinate officers and employes in the departments in both the classified and unclassified service; all appointments to be upon merit and fitness alone, and in the classified service all appointments and removals to be subject to the civil service provisions of the charter:

(c) To exercise control over all departments and divisions created by the charter or that may be hereafter created by the commission;

(d) To attend all meeting of the commission with the right to take part in the discussion but having no vote;

(e) To recommend to the commission for adoption such measures as he may deem necessary or expedient;

(f) To keep the commission fully advised as to the financial condition and needs of the city; and

(g) To perform such other duties as may be prescribed by the charter or be required of him by ordinance or resolution of the commission.

Departments, city plan board, and advisory boards are established and may be combined or separated by ordinances of the commission, the general and some specific duties of those of law, public service, public welfare, public safety and finance being prescribed in the charter.

The city manager has the appointment and control of all officers and employes in the departments except certain rights and duties of the fire and police chiefs regarding firemen and policemen and the regulations of the civil service board, made up of three members with six-year terms of office one being appointed each two years by the city commission.

Elective officers not subject to the civil service board.

The elective officers and the city manager are not subject to the civil service board. The city manager can appoint and remove independently the heads of departments, and of divisions of departments, his deputies and secretaries and a deputy and a secretary for each department. Members of appointive boards and the clerk of the city commission are also in the unclassified service.

All other city employes are governed, as to determination of qualifications for appointment or for promotion, demotion, or discharge, by the rules of the civil service board, three classes of employes being set forth in the charter:

(a) The competitive class, includes all positions and employment for which it is practicable to determine the merit and fitness of applicants by competitive examination.

(b) The non-competitive class consists of all positions requiring peculiar and exceptional qualifications of a scientific, managerial, professional, or educational character, as may be determined by the rules of the board.

(c) The labor class includes ordinary unskilled labor.

There are many provisions of details of making improvements and assessments and appropriation of property which seem to be necessary under the Ohio laws. Some rather antiquated methods of procedure are retained, such as notifying property owners to construct or repair their sidewalks instead of treating them like other street improvements. Three methods of making assessments are provided from which choice must be made for each ordinance:

(a) By a percentage of the tax value of the property assessed.

(b) In proportion to the benefits which may result from the improvement.

(c) By the foot frontage of the property bounding or abutting upon the improvement.

Interesting provisions are that the amount of assessment upon any piece of property shall not exceed the benefits to it, and the amount assessed against it in five years shall not exceed one-third its actual value after the improvement is made. The latter is apparently a difficult matter to determine, but it puts the limit at a more equitable figure than the usual provision that the assessments on a piece of property in a year shall not exceed, say, half the assessed valuation of the lot before the improvement. The city is required to pay at least 2 per cent. of the cost of any special assessment improvement and also the cost of intersections, which may be paid from proceeds of bonds not included in the statute limitation of indebtedness of the city. Replacements of street improvements cannot be assessed on the property in excess of half their cost for fifteen years after the original improvement was made. Assessments are made in advance of construction, so that supplementary assessments and rebates are provided for, always troublesome and probably more expensive than borrowing money to pay the contractor or requiring him to wait until the collections are made after the exact cost is ascertained. The commission can provide for construction of improvements by day labor. Bonuses and forfeitures for time saved or lost in completing contracts are provided for.

Franchises are subject to referendum on petition, cannot be exclusive and cannot be renewed before one year in advance of expiration. They must provide price or method of determining price in case city wishes to purchase, which price cannot include the value of the franchise.

A detailed budget is provided for to be reported by the city manager on November 1. Hearings on the appropriation ordinance and publications are provided for and the ordinance must not be passed until the second Monday in January nor until ten days after its publication, altho the fiscal year begins January 1.

The commission fixes salaries of heads of departments, its own employes, policemen and firemen, and members of boards in the unclassified service.

The city manager fixes all other salaries and numbers of employes. The salaries must, however, be uniform in all departments for the same grade of service as classified by the city manager under the rules of the civil service board.

Amendments to the charter may be made by the commission if approved by the voters at an election or by initiative petition of 10 per cent. of the voters if likewise approved.

The success of city government does not depend so much upon the form of the government as upon the real desires and demands of the citizens, but the Dayton plan certainly makes its possible for the voters to determine promptly and decisively what form of government they desire. The voters have but two or three offices to fill at a time and can concentrate their attention upon the ability of the

candidates to become good directors of their business. And if the men elected prove to be incompetent or dishonest, they can be displaced. Very properly, the trouble of displacing them is made sufficiently great to prevent frequent changes in response to whims or sudden changes of opinion regarding men which have insufficient basis in fact.

This is the most promising experiment in city government which has yet been made. It will undoubtedly be tried in other cities before those now having it under way have demonstrated its possibilities of success.

American Road Congress at Detroit

The very attractive program of the third American Road Congress, to be held at Wayne Garden, Detroit, Mich., September 29 to October 4, will occupy practically the whole week, the evenings and the afternoon of Wednesday being given over to social features and the remainder of the time to the sessions, which are distributed among various organizations interested in the congress.

The Monday morning session is introductory with the addresses of welcome and encouragement. The afternoon belongs to the national administrations of the United States and Canada, with addresses by officials and a paper written by President Wilson and read for him.

National legislation will be the subject of the Tuesday morning session under the charge of the American Automobile Association, and the Lincoln Highway Association will occupy a part of the time. Addresses are expected from Representatives Jonathan Bourne, Jr., and Dorsey W. Shackleford and Senator Claude A. Swanson., presenting the various plans for national aid for road building and it is hoped that some definite plan can be agreed upon which the road congress can recommend to the national congress.

The afternoon session, conducted by the American Bar Association, will discuss state legislation and road management. There will be addresses by William D. Sohier, chairman of the Massachusetts State Highway Commission, on the recent International Road Congress in London; by John A. McIlhenny, president of the United States Civil Service Commission, on the merit system in road management; by James R. Marker, Ohio State Highway Commission, on the evolution of road legislation in Ohio; by Henry G. Shirley, chief engineer of the Maryland States Road Commission, on systematizing the purchase of road material and equipment.

Wednesday morning is the engineers' day under the charge of the American Highway Association, at which construction and maintenance problems will be considered. A long list of papers is provided, which papers will be printed in advance and distributed so that they can be read by title only and the time can thus be devoted to discussion of the material provided. State highway commissioners and engineers of Virginia, Louisiana, Maryland, Alabama, Minnesota, New Hampshire, Oregon, New Jersey, Kentucky, Pennsylvania, Ontario, Michigan, Maine, Wisconsin, Iowa, California, Illinois and Massachusetts are on the list of speakers, also the county engineer of Cuyahoga county, O., the chairman of the Baltimore Paving Commission, the director of the United States Office of Public Roads, and several experts upon allied subjects. Unsurfaced, gravel, bituminous macadam, brick, concrete, road construction and maintenance, the labor problem, the handling of working forces, the selection of road materials, dust prevention, drainage structures, conservation of road equipment, systematizing and accounting for purchase and placing of construction and maintenance materials, the merit system in road management, financing road improvement, bond issues, economics of road improvement, California's system, contract law, dirt roads and politics, and the London International Congress, are the subjects chosen by or assigned to the speakers named.

Friday is Michigan day, under the auspices of the State Good Roads Association, with Michigan speakers. The business meeting of the American Highway Association will be held in the evening.

About seventy exhibitors of materials, methods and accessories are announced in advance and the United States Department of Agriculture will exhibit the largest and best collection of models and pictures yet presented.

The American Road Congress has evidently become a short session training school for road officials where they can get full information, see the results and collect a vast amount of literature and instruction at a minimum expenditure of time and money.

American Public Health Association

The forty-first annual meeting of the American Public Health Association will be held at Colorado Springs, Colo., September 9 to 13, under the presidency of Rudolph Hering.

The general sessions will include a symposium on the control and improvement of food supplies with seven papers and at least twenty-five other papers on public health problems.

The laboratory section, F. P. Gorham, chairman, has about twenty-five papers on technical laboratory subjects, including some on water analysis, putrescibility tests, purifying swimming pool water, sanitation of harbors, and a number on bacteriological determinations.

The section on vital statistics, W. S. Rankin, chairman, has a list of eighteen items on its program.

The public health officials' section has a dozen papers or more, including committee reports.

The sanitary engineering section, J. L. Ludlow, chairman, has a well classified program with six papers under the committee on air supplies, on factory and school ventilation, air washing and ozonization; five under the committee on water supplies on sterilization, economies of overdosing of coagulants, softening and decolorizing, corrosion of metals and hygienic aspects; five under the committee on street cleaning on recoverable values of city refuse, night collection, recent progress in methods and results and on contract and municipal labor methods of collection and disposal and accounting.

There will also be several papers on sewage and refuse collection and disposal, on river and stagnant pool cleaning, etc.

The sociological section, Homer Folks, chairman, will have ten papers in three sessions under the general subjects of the sociological aspects of recent reorganizations of health departments, securing funds for public health work, and some economic aspects of health. Selskar M. Gunn, 755 Boylston street, Boston, Mass., is general secretary.

National Paving Brick Manufacturers' Association

The annual meeting of the National Paving Brick Manufacturers' Association will be held at the Statler hotel, Cleveland, O., on September 17 and 18. The afternoons of both days will be spent in the inspection and criticism of brick pavements under construction and in the inspection of some of the older streets and roads included in the thousand miles or so of brick roads and pavements in Cleveland and Cuyahoga county. Prior to the convention, on the 15th and 16th, a party will visit paving brick plants in the vicinity of Cleveland to see what the processes of manufacture are as a basis for determining the practicability of various specifications for paving brick which have been proposed. The city, county and state officials will aid in making the arrangements pleasant for members and guests. A banquet on the evening of the 17th will give opportunity for an exchange of opinions.

The International Municipal League

On the initiative of the Union of Canadian Municipalities, a movement is under way for a union of various organizations of municipal officials and those interested in better municipal government to which the National Municipal League of the United States, the Union of Canadian Municipalities, the Municipal Association of New Zealand, and the National Association of Local Government Officers of England have given their approval. Similar organizations in England, Scotland, South Africa, the United States, Australia, etc., are considering the project favorably. Clinton Rogers Woodruff, North American building, 121 South Broad street, Philadelphia, Pa., is the temporary secretary, pending the completion of the organization.

The Efficiency Society

The Efficiency Society, 29 West 39th street, New York, has an attractive program for the coming season, beginning with a three days' conference at Lake Placid, September 19-21, on efficiency in non-profit-sharing establishments such as churches, hospitals, schools, colleges and the government. In January there will be a three days' conference on profit making industrial enterprises and an efficiency exhibition at the Grand Central Palace, New York City. Dinner meetings will be held each other month, at which will be discussed: In October, analyzing efficiency; November, standard organization; December, progress in scientific management, including financing and business credit system; February, elements of costs; March, mechanical appliances, including freight handling, shipping, packing, cartage and transportation; April, efficiency in the use of supplies, including storage; and in May, home economics.

St. Paul City Planning Conference

For the purpose of developing and promoting the improvement of the city on the lines of the city plans devised by John Nolen, of Boston, and Cass Gilbert, of New York, in connection with his plans for the State Capitol, the Civil Engineers' Society of St. Paul, the Gargoyle Club, the Garden Club members, the Real Estate Exchange and the Women's Civic League have formed the City Planning Conference of St. Paul, which has individual members also.

Seven committees will make the investigations and reports to the conference on city planning; traction lines, railroads and river docks; public buildings,

open spaces; tenants of buildings, relative to street and location, including housing; legal administrative methods; municipal real estate improvement, and taxation.

The business of the conference will be transacted by an executive committee made up of delegates from the component clubs, the officers and the chairmen of the standing committees.

One annual meeting and exhibit will be held by the conference each year, and each committee is expected to provide a program each year for a meeting devoted to its special subject.

Calendar of Technical and Trade Society Meetings

American Concrete Institute. Secretary, Edw. E. Krauss, Harrison Building, Philadelphia, Pa. Tenth annual convention, Feb. 16-20, 1914, at Chicago.

American Gas Institute. Convention, Oct. 15-18, at Richmond, Va.

American Highway Association. Secretary, J. E. Pennybacker, Jr., Colorado Building, Washington, D. C. Meeting at Detroit, Sept. 29 to Oct. 3.

American Institute of Electrical Engineers. Secretary, Frederick L. Hutchinson, 29 West Thirty-ninth street, New York. Meets second Friday. Pacific Coast convention, Sept. 9-11, at Vancouver, B. C.

American Public Health Association. Secretary, Selskar M. Gunn, 755 Boylston street, Boston, Mass. Convention, Sept. 8 to 13, at Colorado Springs.

American Road Builders' Association. Annual convention, First Regiment Armory, Philadelphia, Pa., Dec. 9-12. E. L. Powers, Secretary, 150 Nassau street, New York City.

American Road Congress. Third annual meeting at Detroit, Sept. 29 to Oct. 3.

American Society of Civil Engineers. Secretary, Charles Warren Hunt, 220 West Fifty-seventh street, New York. Meets first and third Wednesday, except in July and August, in New York. Next outside meeting, Oct. 15 to 18, at New Orleans.

American Society for Municipal Improvements. Secretary, A. Prescott Folwell, 50 Union Square, New York City. Annual convention, Oct. 7-10, at Wilmington, Del.

American Wood Preservers' Association. Secretary, F. J. Angier, Mount Royal Station, Baltimore, Md. Convention, Jan. 20-22, 1914, at New Orleans, La.

Federation of Trade Press Associations. Secretary, E. C. Johnston, New York. Convention, Sept. 18-20, 1913, at Hotel Astor, New York.

Illuminating Engineering Society. Annual convention at Pittsburg, Pa., Sept. 22-26. Secretary, I. D. Israel, 29 West Thirty-ninth street, New York City.

International Association of Fire Engineers. Forty-first annual convention, Grand Central Palace, New York City, Sept. 1-6. James McFall, Secretary, Roanoke, Va.

National Paving Brick Manufacturers' Association. Secretary, Will P. Blair, Brotherhood of Locomotive Engineers' Building, Cleveland, O. Annual convention, Sept. 17 and 18, at Cleveland.

New England Water Works Association. Annual convention, Philadelphia, Pa., Sept. 10-12. Willard Kent, Secretary, Narragansett Pier, R. I.

United States Good Roads Association. John H. Bankhead, President; J. A. Rountree, Secretary, 1021 Brown-Marx Building, Birmingham, Ala. Convention, Nov. 10-15, at St. Louis, Mo.

Technical Schools

Bulletin No. 32 of the Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa, contains a report of a topographical survey of the Spirit and Okoboji lakes region by H. C. Ford, the survey having been made by the various classes in civil engineering in the college during the past five or six years.

The plans for the new location of the Massachusetts Institute of Technology have reached the construction stage in part and the Stone and Webster Engineering Corporation have been selected as the construction engineers. The total expenditure on buildings and grounds will be fully $3,000,000.

The New York University School of Commerce, Accounts and Finance, Washington Square, New York, announces a special one-year course in real estate, covering contracts, duties of brokers, taxes and assessments, building loan operations, planning a building, apartment house management, investments, law of contracts, agency, sales and mortgages, etc. Joseph French Johnson, dean.

The Stuyvesant Evening Trade School, 15th and 16th streets, near First avenue, New York, announces a course in structural engineering design to begin September 15, with Sidney Diamant as instructor.

The School of Commerce, Accounts and Finance of New York University, Washington Square, New York City, in its recent periodical bulletins outlines its courses in accounting, finance, law, public affairs, journalism and English, etc., and makes the announcements of programs for the coming school year, beginning September 16.

U. S. Civil Service

The United States Civil Service Commission will hold examinations at the usual places as follows:

Sept. 15: Electrometallurgist in Bureau of Mines, Department of the Interior, at $1,800 to $3,000 a year.

Sept. 17: Examiner of surveys in Forest Service, Department of Agriculture, at $1,200 to $1,500 a year.

Sept. 17, 18: Assistant engineer in forest products in Forest Service, at Madison, Wis., at $1,200 to $1,500 a year.

Edward D. Rich

The first incumbent of the new office of sanitary engineer for the Michigan State Board of Health is Professor Edward D. Rich, who bas been assistant professor of civil engineering at the University of Michigan for the last five years. He is one of the few in the corps who retained their places after the recent reorganization of the department. Professor Rich is well qualified by education and experience for the work which has been assigned to him. His engineering work has been upon the water works and in the city engineer's department of Syracuse, N. Y., on the New York state canals, as city engineer or assistant chief engineer of Utica, N. Y., and Summit, N. J., with some railroad experience. He was an engineering student and an instructor at Syracuse University and is a graduate of Rensselaer Polytechnic Institute. Much of his work at the University of Michigan has been in the line of municipal engineering.

Professor Rich is a young man of energy and good judgment and with his basis of training and experience will undoubtedly give his department a high professional standing and usefulness.

Personal Notes

Arthur H. Blanchard, M. Am. Soc. C. E., professor in charge of the graduate course in highway engineering at Columbia University, has been retained by the State Highway Department of Pennsylvania as consulting engineer on the appraisal of certain toll roads, and also as consulting highway engineer by the Department of Efficiency and Economy of the State of New York.

Prevost Hubbard, in charge of the division of roads and pavements of the Institute of Industrial Research, Washington, and lecturer in engineering chemistry in Columbia University, has been retained as consulting highway chemist by the Department of Efficiency and Economy of the State of New York.

Gilmore and Cook, consulting engineers, Binghamton, N. Y., are engineers of the new gravity spring-water supply of Lisle, N. Y., which will include storage reservoirs, and 2¾ miles of pipe, giving 70 pounds pressure for fire protection to the village.

T. M. Hammond has been appointed city engineer of Port Townsend, Wash., to fill the vacancy caused by the resignation of William J. Sadler.

Publications Received

Ninth Annual Report of the Artesian Water Department of Memphis, Tenn., for 1912. Carl E. Davis, resident engineer. Paper, 56 pp.

Report of Frank E. Merrill, Water Commissioner of Somerville, Mass., for 1912. Paper, 43 pp.

Special Report on the Flood of March, 1913, prepared under direction of Dr. E. F. McCampbell, Secretary of State Board of Health, Columbus, O. Paper, 175 pp., being the May number of the Board's Monthly Bulletin.

Report of the Commissioners of the Water and Light Department of Duluth, Minn., for 1912. Paper, 61 pp. T. T. Hudson, president.

Bibliography of Smoke and Smoke Prevention, compiled by Ellwood H. McClelland, technology librarian, Carnegie Library of Pittsburg. Bulletin No. 2 of the smoke investigation by Mellon Institute of Industrial Research and School of Specific Industries, Robert Kennedy Duncan, director. Paper, 164 pp., 50 cents.

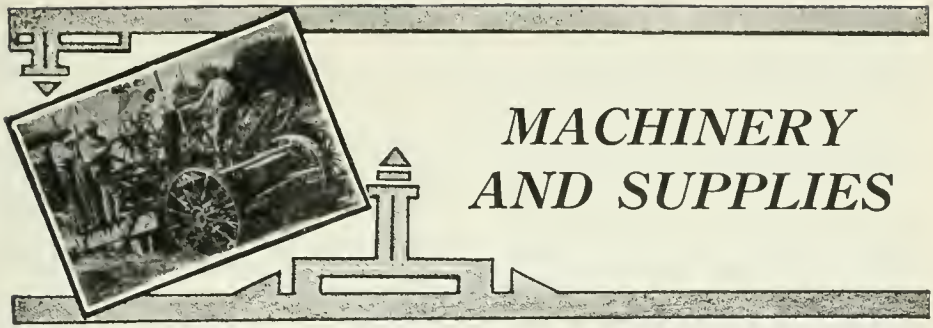
The Determination of Internal Temperature Range in Concrete Arch Bridges. By C. S. Nichols and C. B. McCullough. Paper, 101 pp. Bulletin No. 30 of Engineering Experiment Station, Iowa State College of Agriculture and Mechanic Arts. Ames, Iowa.

Report and plans for reclamation of lands subject to overflow in the Embarrass river valley. By Jacob A. Harman, C. E. Cloth, 61 pp. and maps, 7 cents postage. Bulletin No. 25 of Illinois State Geological Survey, Frank W. DeWolf, director, Urbana, Ill.

Housing Report to the Newark, N. J., City Plan Commission, made for E. P. Goodrich and George B. Ford by Dr. James Ford, Harvard University.

Report on the Application of Ozone to Water Purification, by Russell Spaulding, consulting ozone engineer, New York State Department of Health, Albany, N. Y. Paper, 45 pp.

Progress Report of Experiments in Dust Prevention and Road Preservation for 1912. Prepared by Office of Public Roads, Logan Waller Page, director, Washington, D. C. Paper, 51 pp.



MACHINERY AND SUPPLIES

Expansion and Contraction in Concrete Pavement Construction

By C. G. Allen, C. E.

It is well known to engineers that concrete contracts and expands. Many have assumed that these phenomena are solely a function of temperature changes, but this is not altogether certain. It is a matter of engineering observation that concrete pavement expands and contracts in climates and under conditions where temperature changes are neither frequent nor extreme. Contraction and expansion, irrespective of their cause, act in one of two ways: They rupture the concrete or they induce initial stresses in the material. Irrespective of their causes contraction and expansion have to be provided for and they are now commonly provided for in designing concrete pavements. Long retaining walls are provided with expansion joints or reinforced against rupture by expansion and contraction. Bridge spandrels are invariably provided with expansion joints. Expansion joints are stipulated generally in sidewalk and floor construction. Sometimes they are provided in reinforced concrete buildings, and the reason that they are not generally provided is that building framework is sufficiently flexible to adjust itself to the moderate distortions likely to result from expansion and contraction. It is quite true that expansion and contraction cracks occur in concrete structures of all the kinds named, but this is due to faulty engineering and not to fault in engineering knowledge.

The chief factor, however, which influences the expansion and contraction of concrete pavements is the weather. As the pavement dries out, the top coat shrinks more than the bottom. The effect can often be seen in sidewalks where the contraction has dished the entire slab so that shallow puddles of water stand in them after a rain. As the walk is wet by the rain the top expands more than the base. The alternate bending stresses thus developed all too often show themselves after a few years when the top coat splits off the base.

The necessity of expansion joints in concrete pavements is now well recognized, altho they are put in principally to take care of expansion due to change of temperature. Many experiments on both neat and sand briquettes indicate that the expansion of cement kept wet ceases at the end of a year, and that the total expansion does not amount to over 0.1 per cent.

One of the lately designed and successful expansion and contraction joints for concrete pavements is known as the Thomas System Sure Anchor Edge Protector. These protectors very effectively protect the edge of the concrete and being made of soft steel wear in the same ratio as the surface of the concrete pavement itself. It is impossible for them to wear down any faster than the wearing surface of the concrete, as the traffic affects them in the same ratio as the wearing surface of the street. These protectors are equipped with S-form hooks made of round steel placed at regular 10-inch intervals along the plate which anchor the plate firmly along the edge of the concrete surface. Inasmuch as these S-shaped hooks penetrate into the mass of concrete to a distance of 5½ inches there is no chance for the plate to move from its proper position. These sure anchor protectors are patented and furnished by the Thomas Steel Reinforcement Co., Detroit, Mich.

A Modern City Jail

The longitudinal and floor plan sections herein illustrated were planned and built for Salt Lake City, Utah, by the Van Dorn Iron Works Co., Cleveland, Ohio.

The building is of brick, with floors of I-beam and concrete construction, the cell room having steel stairs and ceilings, thus making it an entirely fire proof structure.

The basement contains the kitchen and serving room, from which it is possible

to feed all departments by means of a dumb waiter.

The drunk cell, which is a very important feature, is conveniently situated, being remote from the various departments so as to make it impossible for noises to be heard elsewhere. In the rear part of the basement is located the cell room, containing cells for vagrants and "sobered-up" drunks; this department is entirely isolated from the department above. We have also provided a prisoners' laundry for their use; also a store, coal and boiler room.

The first floor is very convenient in every respect. The prisoner upon being brought in, is taken to the sergeant's room, where he is searched and registered, after which he passes directly into the main cell room and is taken to his assigned cell. This cell room contains three tiers of cells of the most up-to-date construction, of which each is provided with one prison water closet and two bunks. Each water closet has its own vent, and in addition each of the cells has vent registers near the floor and ceiling which connect into the diagonal vent shaft as shown.

The cells are equipped with the celebrated "Van Dorn Sliding doors and Lever-Controlling Mechanism," which is operated from the entrance corridor, thus insuring the safety of the turnkey. In the prisoners' corridor is a sink supplied with hot and cold water. The floors of these cells are made of steel with 3-inch concrete dressing on top.

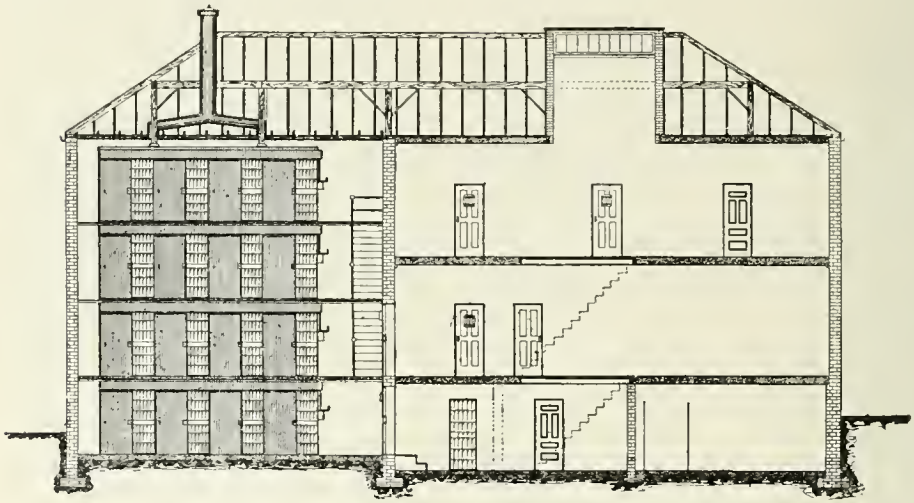
The two burglar-proof cells in the second tier are constructed of the Van Dorn "White Diamond Steel." In front of this cell room is located the bath room, containing shower bath and sink supplied with hot and cold water. The various tiers are reached by means of iron stairs.

The emergency hospital is located near the entrance and is used for city accidents.

The juvenile department contains five cells of similar construction as used in main cell room. This department has also all modern conveniences.

The special department is made up of the insane or padded cell and the dungeon cell, which are especially constructed for their own purposes.

The second floor contains the feminine and minor female departments. The female cells are constructed of Bessemer steel and provided with all conveniences; the minor female department contains two iron bedsteads. A bath room is provided for the use of these two departments. On this floor are located the matron's and jailer's apartments, which are provided with all conveniences.



LONGITUDINAL *Section of City Jail, Salt Lake City, Utah.*

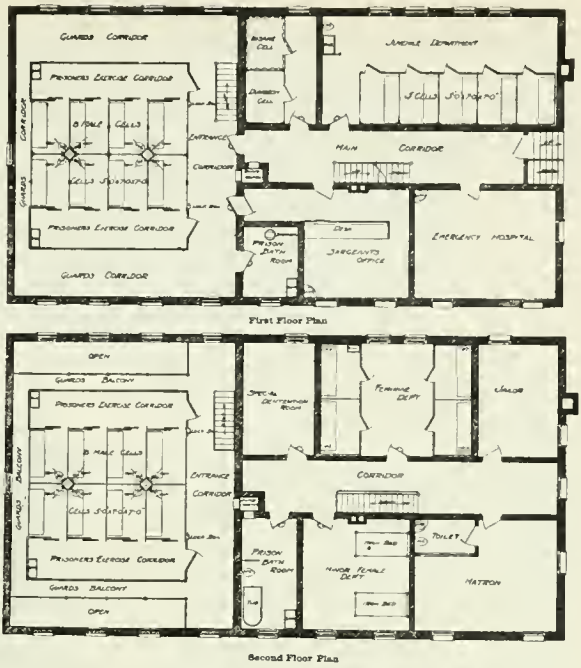
All windows are barred by the "Van Dorn Guards"; all various department entrance doors are made of steel and secured with strong locks and anchor bolts set into the masonry.

All departments are provided with drains so as to allow the free use of the hose for cleansing purposes. The ventilation is of the most modern system.

All departments are well lighted, as are also the halls, having skylights in roof, as shown in longitudinal section.

The question of providing for small towns, and for substations in the large towns, a cheap and neat appearing and also substantial lockup, one that is fire proof and secure and that can be kept in good sanitary condition, has been difficult

to accomplish. The old ways, either to build a wood structure with brick or stone cells, or a brick building with more or less woodwork in connection therewith, without ventilation or sanitary provisions, have been open to much objection. In some places rooms in city halls or other public buildings have been used for this purpose, but the unsanitary condition of these cells has always been a nuisance, not only to the prisoner himself, but to the entire building. The Van Dorn Iron Works Co. also manufacture strong and durable steel fire proof and well ventilated lockup buildings. These cells are of steel and are separated by plate partitions with plate sides, ceilings and floors. They open into a front corridor, to the steel floor of which is securely riveted a stove, the pipe extending into the ventilator. On either side of the corridor is a seat which can be used for a bunk in case of overcrowding.



PLANS *of first and second floors, City Jail, Salt Lake City, Utah.*

The main point in the building is that all the walls are made double, with a system of ventilation which insures a warm building in the winter and a cool one in the summer. Not only are the sides, back and front double, but the ceiling as well; the ventilation taking the cool air from the floor, carrying it up thru the sides into the double ceilings and out thru the ventilator. In the cool weather the stovepipe rarefies the air, thus giving the necessary drafts. The only wood about the building is the sash and strips between the walls, and with any amount of carelessness, fire from the stove or surrounding buildings cannot damage the building to any extent or jeopardize the safety of the inmates. The building can be adapted to set upon any plot that is convenient to the officers. It gives a very neat and tidy outside appearance; the windows are so secured, and high up from the ground, that they are not accessible to the outsider.

Asphaltic Concrete in Racine

By P. H. Connolly, City Engineer, Racine, Wisconsin.

Our experience with asphaltic concrete pavement is limited, due to the fact that we laid none of this pavement prior to the year 1911, at which time we laid an experimental strip of Sarcolithic rubber pavement on Ninth street, from Washington avenue to Center street, a distance of 713.3 feet, or 2,298.73 square yards, exclusive of gutters. The cost was $1.90 per square yard. This pavement consisted of a 5-inch portland cement foundation, 1-3-5, a 2-inch layer of stone and Sarco asphalt mixed and thoroly rolled, a skin coat of asphalt and then crushed granite screenings rolled into this skin coat. It has never been repaired, and has never been cleaned, and yet it is clean and free from dust most of the time. This is due to the fact that there is about a 5 per cent. grade on each end of the pavement, the low point being about half way between the ends. The traffic consists of light vehicles and automobiles with very few heavy traffic teams. This experimental strip, which was laid by the Western Improvement Co., of Racine, Wis., has proven so satisfactory that we will undoubtedly lay more yardage in the near future.

The subject of street pavements has become so important, such enormous sums being spent annually for their maintenance, that the utmost intelligence is required in their laying, both from an economical and utilitarian standpoint. Too much attention, therefore, cannot be given to street pavements, covering as they do so large a portion of a well built city.

They should be selected and constructed with the greatest care and when once completed, watched over and repaired, whenever necessary, in an intelligent manner. It is in this way, and only in this way, that our streets can be maintained in the condition that their importance in the make-up of a city demands.

Location and Setting of Water Meters

By H. M. Lofton, Superintendent Water Works, Chattanooga, Tenn.

The proper installation of meters is one of the most important elements in successful water works management and, as a general thing, entirely too little attention has been paid to this very important part of the water works equipment. The questions of reading meters, testing and repairing are of great importance, and all of these elements should be taken into consideration in both the location of the meter and the type of meter box used.

New Orleans has 40,000 meters installed under one standardization of setting, which has resulted in a very high efficiency of operation and a low maintenance cost. It has also resulted in reducing the cost of reading meters to a minimum, and in putting the full control of meters in the water department, where it properly belongs.

For the general run of metered services the meter should be set in the sidewalk in front of the premises to be served. This permits of the meter being absolutely under the control of the water department and it also makes their control susceptible to such rules and ordinances as may be passed for this purpose. When set in this way, a meter reader can read from two to three times as many meters as he can where they are set in private grounds or in cellars. Likewise, the work of testing and repairing can be effected much quicker and more economically. In the same way the possibility of tampering with the meter is very much lessened when set in the sidewalk, for the reason that one so inclined will not take the risk of tampering with the meter out in public view. Meters set in cellars or private premises are not only more subject to being tampered with but they are unhandy for reading, testing and repairing, as the premises are often locked, making several return trips necessary for the purposes mentioned, which in turn causes delayed water bills, with consequent disputes over their correctness. Even in the coldest climates, meters should be set in the sidewalk, for in this way freezing can positively be guarded against, which is not always true when they are set in cellars and basements.

Meters should be set at such a depth that the dial will come within 15 inches to 20 inches of the surface of the sidewalk. No matter how cold the climate may be, this practice holds good, as it has been proven beyond a question of doubt that if the proper meter box is used and the meters are properly installed, there is not the slightest danger of the meters freezing when set at the depth just mentioned. The particular types and methods of setting meters that will accomplish this result, even in the extremely cold climates, will be referred to later in this article.

STRAIGHT IRON *collapsible form, for making of concrete mixer boxes.*

As to types of boxes best suited for general requirements, they should permit of a proper adjustment in height, so as to bring the top level with the surface of the sidewalk, and whether the casing is of concrete, sewer pipe, or iron, it should be provided with an outer iron rim at the top that will permit the sidewalk paving to be joined solidly with it. The box should also be of a type that will permit the meter to be removed and replaced easily from the surface of the sidewalk without the edges of same coming in contact with the sidewalk paving.

If the cover is equipped with a locking device, it should be free from all trifling and complicated mechanism or such parts as might become inoperative thru corrosion, or that would loosen from vibration due to pedestrians walking on the covers. Where the cover is not provided with

METER BOX *cover sufficiently large to easily admit workman.*

locking device it should be fitted into a deep socket and have a deep ring or deep lugs that would prevent the cover from being easily displaced and that would also require a vertical lift with some special lifting device in removing the cover. There are many worthless locking devices on the market; and as a general proposition, the cover with deep lugs has proven the most satisfactory in service.

The above cut illustrates a type of covers and lids designed by the H. W. Clark Co., to meet the demand for a cover having sufficiently large opening for a workman to enter the meter box without the necessity of digging up the cover, but also fitted with a lid of simple and secure locking type. As shown in the illustration, the 20-inch lid for this cover is provided with an 8-inch opening. Thru this opening, meter readings are easily taken; also the locking device provided for securely fastening the large lid to the cover is very easily operated. When it comes necessary to remove the meter from the box, this is very readily accomplished by simply removing the earth overlying the cover and lifting cover off the meter box, which allows an opening the full size of interior of the box body and without in any manner damaging any part of the installation. This in itself is a decided advantage over the ordinary arched brick pit construction in which it is necessary to partially tear down the masonry to remove meter.

Motor Trucks in Street Paving Work

Substantial economies in the hauling of paving material and supplies have been effected by the Warren Brothers Co., the well-known paving contracting firm of Boston, with two White trucks of five tons capacity and one of 3,000 pounds. In less than a year's experience and without materially changing the facilities that had been developed for horse service, the officers of this company have reduced their hauling costs 33 1-3 per cent., and have placed their order with the White Co. for three additional trucks.

Ten of the twelve horses that were formerly maintained in their big Cambridge yards have been supplanted, and a considerable part of their wagon equipment has been adapted to the use of trailers, with satisfactory results. In addition, the officials are satisfied that they can further reduce their hauling costs by making some changes in their yard facilities, to meet the new conditions of transporting and loading.

The company maintains two asphalt refineries in California and the asphalt is shipped by rail. Crushed stone arrives in railroad cars, cement is delivered by rail or steamship, and gravel reaches the yard in barges from Long Island. Many contracts are made for work in cities and towns quite distant from the Boston institution, and in such cases the necessary equipment and tools are shipped and transportation units are hired. The Boston installation, however, is a permanent institution and the facilities of the Cambridge plant have been developed to meet the requirements of street paving, side walks, buildings, flooring and roofing, in Boston and vicinity.

Gravel is stored in elevated bins or pockets and discharged by gravity, asphalt is unloaded from a spur track, and crushed rock is hauled by an inclined cable railroad, all of which tends to show that the material which is stored in quantities is handled scientifically, and the plant has been improved in practical ways to facilitate the receipt and distribution of material as required for contract work.

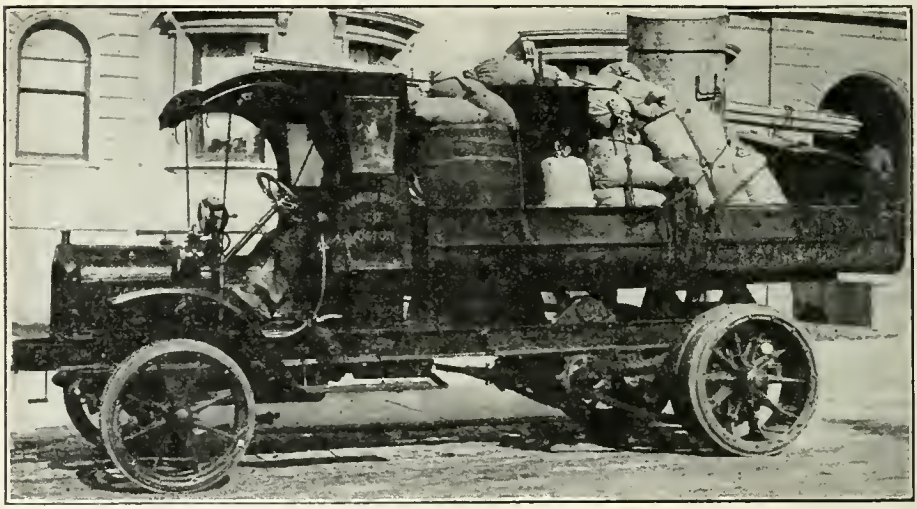
When horses were used exclusively, the operations of the company were limited to a ten-mile radius from the center of of Boston, and the greater part was inside a seven-mile radius including about seventeen adjacent cities. This limit of

carting distance has been due to the fact that the bitulithic surfacing material, which is composed of certain proportions of crushed stone, gravel and fluid asphalt, is mixed at a temperature of 300 degrees in the Cambridge yard, and must be loaded, hauled and dumped before it cools.

The work can be done only in dry weather, making it necessary to have the hauling done as expeditiously as possible. It must be delivered in practically the same consistency as when it is unloaded from the mixer into the dumping body of the truck, and it is also necessary to have a sufficient number of men at work on the paving job to handle the surfacing when it arrives. It is therefore a proposition involving mixing, loading, hauling and dumping with the minimum loss of time.

and on one occasion a contract was performed in Haverhill, thirty-eight miles distant. The trucks were used to carry tools and equipment both ways, saving freight charges and considerable time. The trailers, in addition to hauling surface material, carried the portable furnaces and heating material.

Both of the dump trucks are built with sheet steel bodies of special design, but they are elevated by the standard White power dumping mechanism, which allows an angle of 45 degrees. The bodies are 11 feet long, 6 feet wide, and 18 inches deep, having a capacity of 100 cubic feet. The paving material weighs about 100 pounds to the cubic foot, making a full load exactly 5 tons. The 3,000-pound truck is fitted with a regular stake platform body.



WHITE *five-ton truck in use by Warren Brothers Company, Boston, Mass.*

With several jobs in progress at the same time the utmost reliability is demanded of the trucks. It is apparent, therefore, that losses of time which are inseparable from any animal installation, mean a considerable loss of money. On the other hand, the company figured that a motor truck, in order to be preferable to horses must actually earn $15 a day.

Careful figures which have been compiled by the company, covering both horse and motor truck installations, show that each White truck did the work of three two-horse teams and occasionally four teams. When trailers were used the trucks supplanted five and six teams, according to the character of the work and the distance of the haul. The use of trucks, furthermore, extended the area in which paving contracts could be made,

The Pneumatic Tire

By Chas. E. Swingley, Chief of Fire Department, St. Louis, Mo.

From all the information I could secure in conversation with manufacturers and users of different types and styles of tires, both solid and pneumatic, I have come to the conclusion that under certain conditions and circumstances the solid tire is preferable, and under other conditions the pneumatic tire is advisable. If a high speed is desired, it is necessary to have your apparatus equipped with pneumatic tires, as I am informed that about twenty to twenty-five miles an hour is the limit of speed that it is safe to run on solid tires, unless the streets are free from depressions and projections or high street crossings. In that case, a speed of

about thirty miles an hour may be obtained with safety.

As to pneumatic tires, while there is no limit as to the speed that you can run on them, or say from fifty to sixty miles an hour over all kinds of roads or streets, the mileage per tire is less than that on solid tires.

Then there is a limit to the weight that can be carried on pneumatic tires. Just what that limit is, I am not prepared to state, as it still seems to be undecided by manufacturers and users of tires.

The expense incurred by the replacement of the pneumatic tire seem to be the greatest objection to them. Such being the case, I am informed—and I think truthfully—that the solid tires will cause an addition to the repair account, which in the end would about equal the cost of maintenance.

When we consider the saving to a city by the use of automobile fire apparatus, of which I will give you my experience, we ought not to consider too seriously the cost of tires.

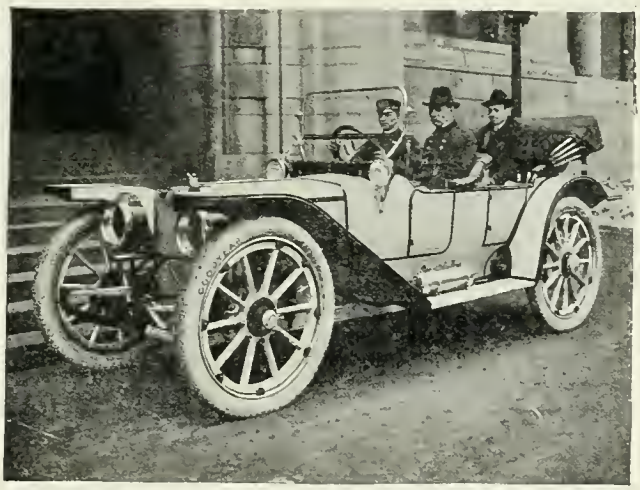
Now, for the first twelve months our automobile fire engine was in service, it covered a distance of 1,163 miles and pumped sixty-four hours, consumed 478 gallons of gasoline and forty-two gallons of lubricating oil; which, compared to a company equipped with horse-drawn apparatus, is a reduction in the expense of maintenance of practically $4,500; and then the automobile company covered three times the distance of the horse-drawn company.

The fact that the automobile can cover a much greater distance in much less time than the horse-drawn apparatus, gives us the desired results, as it is quick time and quick work in reaching a fire that every city and town is trying to accomplish, as you know too well that a fire never waits for your arrival.

With that object in view, are we justified in curtailing expense at the cost of efficiency of the apparatus, or if pneumatic tires cost more than solid tires and give higher efficiency, should the difference in cost, if any, be considered?

There seems to be a desire on the part of tire manufacturers to acquire something that will eliminate tire trouble, and I have seen several devices and preparations that great results are claimed for.

Our chief's car is equipped with Goodyear double-thick, non-skid tires, which are giving excellent satisfaction. This type of tire is also giving very satisfactory service on fire truck, being oversize and having an extra thick tough tread which is vulcanized to the regular tire. These blocks prevent skidding, as they are thick and deep cut. This extra tread is so tough that the tire stands a lot of abuse, and aside from possessing great non-skidding properties is almost proof against punctures. The blocks on this extra tread are set far enough apart to grip and set pavement, but they are not so widely distanced but that the load is evenly distributed over the tire.



CHIEF SWINGLEY'S CAR, *St. Louis, Mo., equipped with* 41x4½ *Goodyear Non-Skid Tires.*

Classification of Water Consumption

By Otto F. Poetsch, Superintendent of Meters, Milwaukee, Wis.

In the past, the department has had to buy or have cut thousands of nipples and connection pipes. By installing a new pipe cutting machine, we are able to cut all these ourselves, thereby cutting down the price of these nipples more than half. Furthermore, a large amount of useless old pipe is recut, so that it can now be used. We operate a complete stock-room, in which all meter repair parts, tools and supplies are kept, properly separated and labeled. The stock room is in charge of a competent stock clerk, who receives all the goods bought, reporting same on proper blanks daily, in order that the bills for same can be correctly checked. A re-

pair order is issued for each meter that comes to the shop for repairs. If a repair man needs any repair stock in order to repair any meter he can get it by presenting the repair order for the particular meter to the stock clerk. The stock clerk charges the parts on this order and also checks out of stock the parts given out, entering same on his list against the particular order number. This list, showing what stock left the stock-room, is sent to the superintendent of meters, daily, for approval, when it goes to the cost clerk in the general office, in order that it can be properly charged and billed.

One hundred of the largest consumers paid $402,563.25, nearly 50 per cent. of the entire revenue received for water, during 1912.

Following gives the classification of metered consumers for the year 1912, the payments being per year:

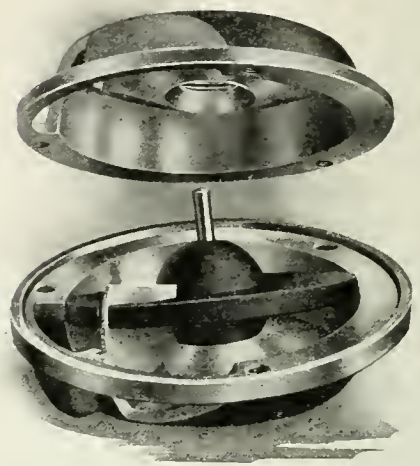
		Per cent.
1,185	less than $0.50	2.10
6,347	between $ 0.50 and $ 1.00	11.00
15,182	between $ 1.00 and $ 2.00	26.33
10,656	between $ 2.00 and $ 3.00	18.48
7,157	between $ 3.00 and $ 4.00	12.41
4,899	between $ 4.00 and $ 5.00	8.50
8,017	between $ 5.00 and $ 10.00	13.90
2,228	between $ 10.00 and $ 20.00	3.86
598	between $ 20.00 and $ 30.00	1.00
271	between $ 30.00 and $ 40.00	0.47
167	between $ 40.00 and $ 50.00	0.29
376	between $ 50.00 and $ 100.00	0.65
428	between $100.00 and $ 500.00	0.76
66	between $500.00 and $1000.00	0.11
80	$1000.00 and over	0.14
57,657		100.00

Beginning January, 1901, a test was begun on water meters that extended thru to 1907. During that time about 10,000 meters were tested.

All meters in service before being set are given a serial number. The start was made with the first meter, beginning with No. 1, and continuing consecutively. The first meters were set in 1882. This test was made on the first 10,000 meters set and included every meter that had not been retested within five years. For the purpose of showing the results of this test, we divide all meters into two classes: Piston-plunger meters and disc meters.

The first 6,000 meters numbering from 1 to about 6,300 were all piston-plunger meters, of the Worthington type. From that time on, in about 1891, mostly disc meters were set, the majority of which are of the Niagara type. The test on the piston-plunger meters was started with No. 1 and extended thru to No. 6,300. These meters were set in service from 1882 to 1891 and at the beginning of test had been in service from 15 to 23 years. Most of these had never been taken off.

Test was made by variation in weight. A tank was placed on a platform scale and 10 cubic feet, as indicated by the meter counter, were drawn into the tank and then weighed, the proper weight for 10 cubic feet being 625 pounds. If the trial



DISC METER *opened to show simplicity of mechanism.*

quantity of water drawn thru the meter weighs more than 625 pounds, the meter is over or in other words it under-registers, and if it weighs less, the meter is short or over-registers.

The result of test on piston meters, as far as could be ascertained, is as follows:

Total of 1689 meters tested, 108,939 pounds over.

Total of 1635 meters tested, 41,339 pounds short.

Total of 107 meters tested, O. K.

Total of 80 meters, did not test.

3,511 meters showed difference of 67,600 pounds over.

Average of 19.7 pounds over, each, or 3.15 per cent. under-registering.

The test of disc meters included those numbering from about 6,300 to 14,000, being set from 1891 to 1895. These meters had been in service about 10 years at the time of test, most of them never having been retested during that time.

The result is as follows:

Total of 835 disc meters tested, 9,189 pounds over.

Total of 952 disc meters tested, 8,474 pounds short.

Total of 168 disc meters tested, O. K.

Total of 52 disc meters, did not test.

2,007 disc meters showed difference of 715 pounds over.

Average of 0.36 pounds over, each, or .057 per cent. under-registering.

It will be seen from the above that the piston-plunger meter made a poorer showing than the disc meters. This is due to the fact of construction and working of meter. The piston was duplex in construction, similar to a duplex piston steam pump with two brass pistons or plungers working back and forth in two brass rings encased in the cylinder or body of the meter. The pistons move forward and backward, alternately, and the stroke of each is counted by means of a lever, which sets between one of the pistons and extends to the counter. The constant movement of the pistons on the rings wears them very gradually. As soon as worn, the water will pass between the piston and rings, which does not record on the counter, thus giving more water than it records.

The disc type of meter has a saucer or flat shaped hard rubber disc, which works within a brass chamber thru which the water must pass. The nutations of the disc of a ⅝-inch meter at about 300 revolutions to a cubic foot are, by means of a pinion shaft connected to a train of gears, recorded on the counter in cubic feet. When this meter becomes worn by the water passing thru, it does not lose in registration, but will, when sufficiently worn, stop registration entirely. This, of course, would be detected very easily by the meter-reader when he comes to take his monthly reading. Same is reported and promptly repaired.

Summing up briefly, the fact is evident that you cannot determine whether a piston-plunger meter under-registers after being in service a number of years. The amount of water passed and recorded by the meter will, of course, be of great use, Take for example a meter set 25 years and consumption only 2,000 feet a year or 50,000 during the entire period. It would be safe to presume that the meter is still correct. Take another meter set 3 years and consumption showing 100,000 per year. From this consumption it would be very evident that the meter needs attention, as that amount of water would wear the meter. The disc type of meter on the other hand will generally record correctly until something breaks or is worn out, entirely, which will stop it from registering at all.

Tile Pipe Sewers Near Chicago

By Herbert E. Hudson, Division Engineer, Board of Local Improvements, Chicago.

The provision of proper sewer facilities for its rapidly growing population is one of the greatest engineering problems which confronts the city of Chicago. There are many interesting points that might be covered in a discussion of the subject which would lead into questions that would concern both the state and the nation, and even reach out to international problems if the work of the sanitary district of Chicago were included in the scope of the study.

However, the problem that approaches closest to the owner of property lying within the city limits is the disposal of household sewage wastes by the quickest and most economical method. Most property owners are willing to allow the broader scientific questions concerning ultimate disposal of the city's wastes to rest upon the shoulders of the municipal au-

THIRTY-THREE-INCH *vitrified sewer pipe ready for installation in Chicago suburb. Shown through courtesy of Blackmer & Post Pipe Company, St. Louis, Mo.*

thorities and their consultants. Their interest, however, is aroused when they are confronted with the proposition of installing a sewer immediately adjoining their property.

This interest seems more or less lukewarm among the owners in Chicago and there are very few owners who have ever made it a point to thoroly investigate what was being done along these lines or why it was done any particular way. Owners of property abutting upon sewer improvements in Chicago are more prone to complain of the condition of the surface of the street during the progress of the work and after its completion than to investigate the actual methods of design and construction of the work itself.

There are, I believe, several reasons which control this lack of interest. First, the design of any sewerage system is very technical in its nature and therefore not easily explained to or understood by the ordinary layman. Second, the construction is more or less complicated by all the different appurtenances, such as manholes, catch basins, slants, house drains

and household sewerage systems. Third, and perhaps most evident, altho least valid of all, is the fact that upon completion the whole work is covered and therefore out of sight.

The extension of Chicago's sewer system into its outlying districts has several phases that are not evident upon cursory investigation. The growth of the city has compelled the extension of the sewer system at such a rapid pace that the only satisfactory method of financing these extensions is by special assessment. If the large systems were to be paid for from the general fund, it would require an enormous increase in the general taxes. As the improvements and their benefits are local in their nature, the application of the special assessment or special tax is entirely just. However, the engineer of the board of local improvements, in making estimates, is confronted with the problem of providing mains and laterals at a cost which will not be too burdensome upon the property owners or excessive as compared with property values. These restrictions can easily lead to errors that will later become serious. First, insufficient mains or laterals may be provided. Second, insufficient provision may be made for the future growth of the population of the district under consideration. Third, the annexation of suburban property may make additions to the drainage district and produce conditions that cannot properly be met under a strict compliance with the special assessment laws of the state of Illinois.

The first error is a false economy upon the part of the engineer. Health conditions may demand the installation of sewers in district that will require the building of large mains. The costs of these mains, coupled with the cost of the lateral systems, may be excessive as compared with property values. Economy in the construction of these systems may be justifiable in many cases but will surely result in an expensive rebuilding of the systems later.

The second is a question of judgment, or, perhaps a thoro study of population conditions. The sewer systems designed for the old town of Lake View and many other portions of the city are suffering from improper provision for population growth. The construction of flat buildings and intensified housing facilities have produced conditions that it was almost impossible to foresee. Chicago today is replacing many of these inadequate sewers with newer and larger systems. By the use of the large intercepters and sewage pumping stations, better depths and gradients are obtained. In many cases, the sewers in the streets are being replaced by the same size, or in some cases, smaller sizes of tile pipe sewers that offer better drainage by virtue of these intercepters, coupled perhaps with a more competent design. The writer has had charge of the removal of several systems which were taken up to make room for the installation of both intercepting sewers and lateral systems draining into them. These sewers were removed simply to provide for the larger sewers and to take advantage of the better depths offered to the lateral systems, and in many cases, tile pipe sewers which have been laid for twenty-five or thirty years, and which were in perfect condition, were removed.

The third error in which the engineer may find himself is one that cannot properly be handled under the existing legal conditions. It is noteworthy in this connection that two or three of the suburbs of Chicago have made the sewerage problem a basis of argument for annexation to the city. Under existing conditions, these arguments are especially good and they should receive much consideration by the suburban towns, particularly when the town sites lie within the water sheds of the Chicago systems.

Securing the Proper Mix

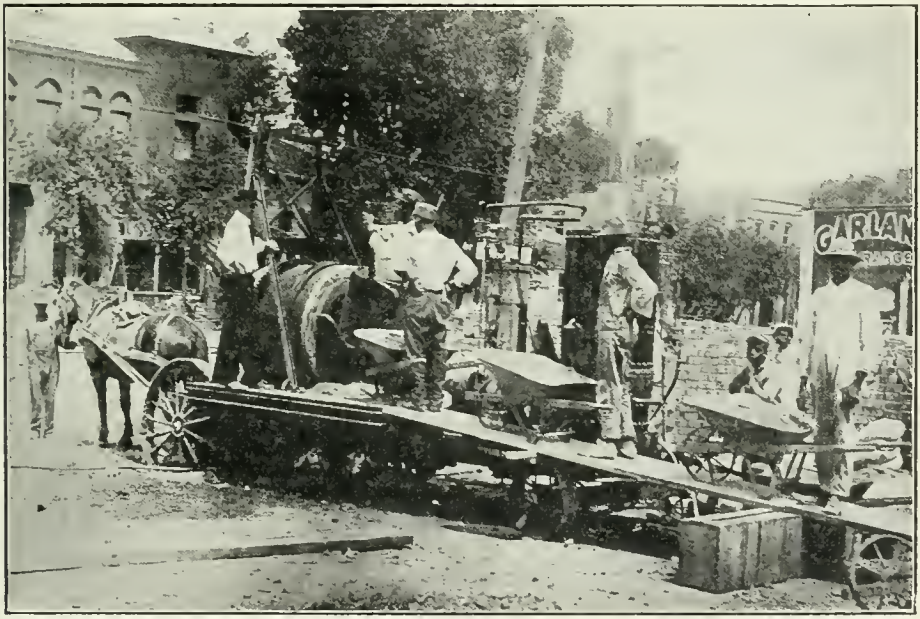
By Ritchie Brothers, Contractors, Topeka, Kans.

One explanation to be offered for failures of concrete roads due to disintegration or raveling under traffic is probably as much a lack of mortar in the concrete as a lack of cement in the mortar. The conclusion from observation is that with a given aggregtte there will be little difference between roads built in proportion of 1, 2½, 5; 1, 2, 3, or 1. 1½, 3, for in each instance, assuming that the aggregate runs precisely the same, there is but 50 per cent. mortar, and where a 1, 2, 3 mixture might have given unsatisfactory results, this condition would not be greatly bettered by using merely a richer mortar. What should be done is to increase the per cent. of mortar. For example, instead of 1, 2, 3 mixtures, to use 1, 3, 3½, the point being, that, in order to secure the requisite strength, the walls of matrix between the particles of aggregate must be of sufficient thickness to hold firmly on all sides each piece of aggregate. To be sure of this requires an excess of mortar over the voids in the aggregate of 10 to 15 per cent. In general it is recommended that the mortar should not be less than 60 per cent. of the aggregate.

The fact that the action of traffic subjects every portion of the exposed surface of the pavement to severe treatment makes it necessary to have the requisite strength presented at all points.

Therefore, concrete for concrete roads must be more thoroughly mixed and of higher grade than is necessary in any other form of concrete construction.

Each batch of concrete as deposited in the road should be watched that the mortar does not flow to the edge of the pike and leave a core of aggregate unsupplied with sufficient mortar. At least one workman should be assigned to shovel all such cores of aggregate to the bottom of the concrete layer so as to insure only cement rich in mortar at the surface. If this is not done, depressions will develop in the surface under traffic which will loosen the clusters of pebbles of the aggregate, which do not have sufficient mortar to hold them fairly in place.



"STANDARD" LOW CHARGING *concrete mixer on street paving work, Topeka, Kas.*

The men finishing the surface should be warned not to let such places go by them without shoveling out the pebble clusters and replacing them with a richer mixture. A finisher can easily cover such a place by working a film of mortar on the surface without necessarily filling the voids below.

We have quite recently completed forty blocks of paving at Topeka, Kans., and are now working on a large contract at Wichita, Kans., in which we are using the "Standard" low charging concrete mixer, rear discharge, mounted on truck and equipped with steam engine and boiler, furnished by the Standard Scale and Supply Company, Chicago. With a gang of twelve men (two spreaders, seven wheelers, one engineer and one man each on discharge and cement pile) we have been easily averaging 900 to 1,100 square yards of 4-inch concrete per day. While the manufacturers of this machine have recently designed a more recent type of street paver, we consider our average record above the ordinary. Our machine drum has an exceedingly large opening in the charging end, thus enabling our operator to keep his eye on the batch while mixing, as it is quite important that every batch be properly mixed before discharging in order to turn out a uniform mix at all times. We credit the general uniform quality of our work to the fact that we are particular mixers. The paving contractor who does a good job at first will be assured of a steadily increasing volume of business. When one street is lined with concrete paving or walks it is only a question of time before the residents of every other street in the town clamor for the same convenience and facility. If the first job is a poor one, the property owners will kick on it, and their kicks will sound all over town and put a damper on the spirit of improvement. The true believer in concrete always wants to enjoin the builder of sorry pavements and walks, for he realizes the damage that is being done to the industry at large. There is so little difference in the cost of good work and poor work that the grafter who cheats concrete of the proper

amount of cement or the proper preparation of foundation or the thoroughness of the mix, is a pitful little piker. Municipal authorities may easily inform themselves of the approximate cost of good pavements and sidewalks, and they owe it to their towns not to accept the bid of the man who must do poor work in order to make a little profit.

Comparison of Cost of Motors and Horses Made by Milwaukee Official

"We have investigated the small motor truck, of 1,000 pounds capacity, and find that it will effect a considerable saving over horse-drawn apparatus," states a leading municipal official of Milwaukee. "In a very short time we will advertise for bids for such capacity trucks for our water and meter departments.

"We have found that the average daily estimated cost of operating a 2-ton truck is $10.83. By comparison, for a 2-horse team the average daily charges have been estimated at $8.50. A 2-ton truck has the capacity to replace two, three or four teams, while larger trucks may replace more horses, so it is a simple matter to see what the saving may be by motor trucks. And this saving is actually the difference between what it now costs for operating horses and what it costs for operating motor trucks, including all such items as interest on the investment, depreciation, insurance, stable or garage, taxes, tires, repairs, wages, gasoline, electricity, oil, light, heat and so forth.

"On investigation we find that one 1-ton Mercury truck will replace the work of three horses and two wagons and at an annual saving which easily pays for the change. The figures which we have verified are as follows for a period of five years:

COST OF HORSE EQUIPMENT.

Three horses	$ 450.00
Two wagons	150.00
Three sets harness	90.00
Feed, shoeing and veterinary, 3 horses each $20.00 per month	3,600.00
Repairs, 2 wagons, $7.50 per year each	75.00
Painting 2 wagons, $25 per year each	250.00
Repairs 3 sets harness	25.00
Two drivers, $12 per week	6,240.00
Total	$10,880.00

COST OF MERCURY TRUCKS.

One Mercury truck	$ 800.00
Gasoline, daily average of 30 miles, 300 days per year	375.00
Barn or garage rental	600.00
Lubricating oil	300.00
Transmission grease	50.00
Recharging batteries	21.50
Repairs, $10.00 per month	600.00
Painting, $25.00 per year	125.00
Tire replacements, based on 1 cent per mile	410.00
Incidentals, cost of oil for lamps, etc.	175.00
One driver, $12.00 per week	3,120.00
Total	$ 6,576.50

Purchasing Coal by Heat Units

By Frank P. Welker, Price & Roberts, Heating and Ventilating Engineers Delaware, Ohio.

During the past two or three years the purchase of coal, or rather the payment for the same, on the basis of the heat units contained therein as shown by analysis has been adopted in general by the various departments and bureaus of the United States government, and a number of cities or city departments have also adopted the same plan. Information concerning this has recently been collected by the Clearing House of the American Society of Municipal Improvements, and we are presenting herewith an abstract of the replies received to inquiries made of more than 100 cities. So far replies have been received from 95, and 20 of these report one or more departments of the city purchasing coal in this way; these cities being Atlanta, Ga.; Moline, Ill.; New Orleans, La.; Cadillac and Grand Rapids, Mich.; Kansas City, Mo.; Omaha, Neb.; Binghamton, Buffalo, New York and Syracuse, N. Y.; Grand Forks, N. D.; Cincinnati and Cleveland, O.; Philadelphia, Pa.; Jackson, Tenn.; Norfolk, Va.; Milwaukee, Wis., and Toronto, Ont. In Atlanta, Ga., coal is purchased on the thermal unit basis by the water department only, the amount approximating 15,000 tons per year. In New Orleans about 8,000 tons per year is so purchased; in Cadillac, 500 tons; in Grand Rapids, 25,000 tons; in Buffalo, 40,000 tons; in New York, 800,000 tons; in Syracuse, 8,250 tons; in Grand Forks, 1,500 tons; in Cleveland, 30,000 tons; in Philadelphia, 117,000 tons (bituminous); in Jackson, 2,200 tons; in Norfolk, 3,000 tons; in Milwaukee, 17,000 tons; in Toronto, 20,000 tons; in Moline, 6,800 tons; in Binghamton, 2,211 tons, and in Cincinnati, 24,885 tons.

In New Orleans the system employed is only indirectly on the heat unit basis, the test being that of the actual evaporation obtained. In Kansas City, the coal for the city is obtained thru the purchasing department. During the last few years the city has been using a great deal of oil and this has lessened the importance of the method of purchasing coal. In Phila-

Tarvia

Preserves Roads
Prevents Dust

Sage Foundation Homes Co., Forest Hills, L. I. Constructed with "Tarvia X" 1910. Treated with "Tarvia B" 1913.

Dust is Expensive

WHEN an automobile speeds down an ordinary macadam road it leaves in its wake a cloud of dust which is carried by the winds over the neighboring fields, houses and lawns.

This is just as surely a waste of good material as if the automobilist dug material out of the highway and carted it away. Dust represents waste—costly waste—and the taxpayers feel the result. A road that is properly built for modern traffic will not be dusty.

Plain macadam gives way under the wear and tear of heavy rubber-tired automobile wheels and the surface binder of the road is torn away in the form of dust, until in time the coarse stone itself is exposed and a costly renewal of the road is necessary.

Modern roads should be built to resist modern traffic. To build any other kind is wasteful. A better binder than the ordinary mineral binder is needed and is offered in Tarvia, a coal tar compound especially prepared for use on roads.

Tarvia is dense, viscid, waterproof. It fills the interstices between the stone and forms a tough, plastic matrix. This makes a waterproof and automobile-proof surface. The maintenance cost is usually so low as to more than balance the cost of Tarvia treatment.

Booklets on Request.

BARRETT MANUFACTURING COMPANY

New York Chicago Philadelphia Boston St. Louis Kansas City Cleveland Cincinnati Minneapolis Pittsburgh Seattle Birmingham

The Paterson Mfg. Co., Ltd.—Montreal Toronto, Winnipeg, Vancouver, St. John, Halifax, Sydney, N. S.

delphia anthracite coal is not purchased in this way, altho bituminous is. Jackson reports that its coal is "not entirely" purchased on this basis. In Norfolk coal is purchased in this way "in some cases."

Inquiry was made as to the saving which is probably effected by this system, to which question the following replies were made:

Cadillac, Mich.—Twenty-five per cent.

Grand Rapids, Mich.—About 10 per cent.

New York City—Many thousands of dollars.

Syracuse, N. Y.—"I do not look for any saving in the total of money expended for coal by this method. We hope and expect to bring the coal purchased up to the standard of the money paid for it."

Omaha, Neb.—About 10 per cent.

Philadelphia—"There is a saving, but impossible to state amount."

The more important parts of the several specifications are given below:

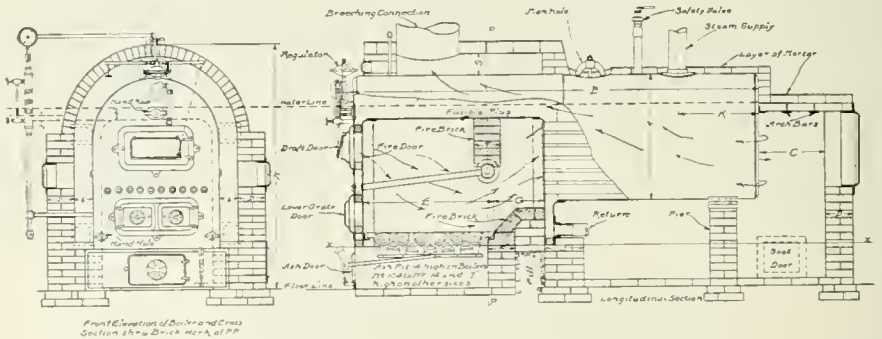
Atlanta—A sample of the coal to be furnished will be analyzed by the water department and the B.t.u., per cent. of volatile matter, ash, sulphur, etc., will be ascertained; and any coal furnished under the contract which does not come up to the test of the sample on which the contract was awarded may be rejected, or deductions in the price may be made as follows: For each 100 thermal units or fraction thereof less than that shown in the sample, the price is diminished 1½ cents, and 1 cent for each one-half of 1 per cent. of ash in excess of the sample.

In Moline, Ill., the standard is not less than 12,000 B.t.u.; not over 10 per cent. ash; not less than 40 per cent. volatile matter; not less than 50 per cent. fixed carbon; not over 5 per cent. sulphur.

In Cadillac the board of education fixes the standard of coal which it will accept as follows: Fixed carbon, over 71 per cent.; volatile hydro-carbons, less than 22 per cent.; moisture, less than 2 per cent.; ash, less than 6 per cent.; sulphur, less than 0.75 per cent. Any coal not coming within 10 per cent. of the above limits may be rejected.

The specifications at Grand Rapids require that heat value per pound of dry coal be stated by the bidder, and if calorimeter tests show the coal to fall below this standard a rebate is made from the contract price, and an increase being made in exact proportion to the B.t.u. For instance, if the bidder guarantees 15,000 B.t.u. per pound and the coal be found to contain 14,000, the contractor would receive 14-15 of the contract price. Any coal which shows more than 5 per cent. less heat units than the fixed standard may be rejected. Standards are established for different kinds of coal, varying between the limits of 15,000 and 11,000 B.t.u., a minimum of 44 to 71 per cent. fixed carbon, a maximum of 15 per cent. to 6 per cent. ash, and a maximum of 3 per cent. to ¾ per cent. sulphur.

In Binghamton, N. Y., it is specified:



PLAN *for setting Kewanee Smokeless Firebox Boiler.*

"No bituminous coal which shows on analysis less than 93 per cent. combustible matter, more than 6 per cent. of ash, or more than 1 per cent. of sulphur, will be accepted. The bidder must submit an analysis of the coal that is bid on, which analysis must show a heating value expressed in terms of B.t.u. per pound of coal. All coal that may in any respect fail to conform to the specifications and analysis submitted with the bid will be rejected.

In New York City the standards for B.t.u. vary from 13,200 per pound of dry coal for broken coal to 12,000 for buckwheat No. 3; and the ash, from 11 per cent. in broken coal to 19 per cent. in buckwheat No. 3. Eight per cent. volatile combustible matter and 1.5 per cent. of volatile sulphur are the maximum amounts allowed. The maximum of moisture is set at 4 per cent. for broken coal up to 6 per cent. for buckwheat No. 3. If the moisture is in excess of the limit, the gross weight of the coal is corrected by an amount directly in propor-

Cubanel

TRADE MARK

CUBAN NATURAL ASPHALT

is being used more and more extensively by leading city engineers, paving contractors and street commissioners as well as by park superintendents and engineers in all parts of the country.

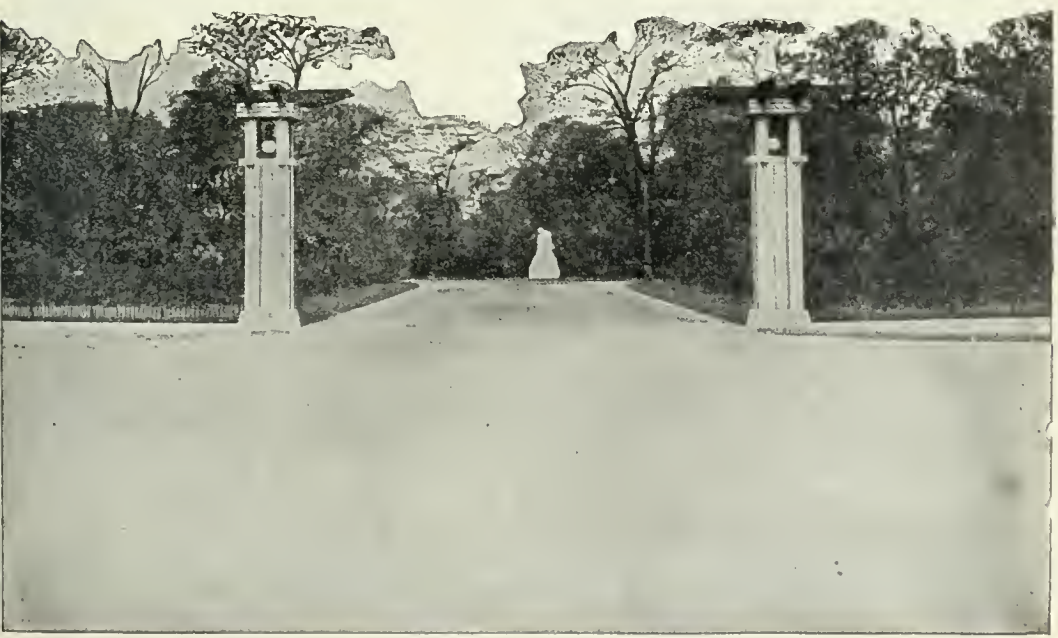
BECAUSE

CUBAN NATURAL ASPHALT CONCRETE insures the most efficient, durable, economical and practically sound-proof pavement with a malleable wearing surface not affected by varying temperature and which is at once waterproof. Its finish gives granular surface which insures good footing, will not pulverize into dust nor will show no movement during summer months or become brittle during the cold months.

Send us specifications covering your requirements and we will gladly send you prices on Cubanel macadam road binder, sheet asphalt, brick or granite filler.

International Asphalt Company,

Chamber of Commerce Bldg. **CHICAGO.**



Cubanel Entrance to Humboldt Park, West Chicago Park District, Chicago.

tion to such excess percentage of moisture; that is, if there is 2 per cent. excess in moisture the gross weight of the coal is reduced by 2 per cent. After this deduction has been made, the weight is further reduced at the rate of 1 per cent. for each per cent. of ash in excess of the standard. The gross weight after correction for excess moisture is further reduced at the rate of 1 per cent. for each 100 B.t.u. below the standard; 5 per cent. for each 1 per cent. of volatile sulphur in excess of the standard; 2 per cent. for each 1 per cent. of volatile combustible matter in excess of the standard. Payment for the coal is made on the basis of the gross weight, less deductions made as described.

In Grand Forks the standard is 12,000 B.t.u. and less than 15 per cent. ash. "The price paid for the coal shall be based on the 'net B.t.u. per one per cent' received, as found by accurate calorimetric analysis. This 'net B.t.u. per cent.' shall be determined by multiplying 'B.t.u. with moisture' as delivered by 2,000 and dividing this product (B.t.u. per ton) by the price of the coal delivered in cents per ton plus 60 times the percentage of ash. The cost of removal of ash is estimated at 60 cents per ton. The price of the coal as quoted, divided by the ratio of the 'B.t.u. per one cent' guaranteed to the 'B.t.u. per one cent' actually found by test, shall be the price paid. A 2-per cent. variation either way in ash will be allowed without change in price."

Obviously the first step toward the most economical heat or power production is in the purchase of the fuel that contains the elements of heat, carbon either fixed or in volatile gases, hydro-carbonaceous gases, the proper amount of moisture and a very small amount of ash, sulphur and other non-heat-producing materials.

Following the selection of the best coal, but just as important, is the selection of a boiler or furnace which will utilize the maximum number of heat units which the fuel contains.

The principal fault with the majority of boilers or furnaces (where they are faulty) is due to a construction which allows the heat producing gases to come in contact with the comparatively cool surface of the boiler before they can be burned. This chills these gases, turns them into smoke and renders them of no value, as smoke once made cannot be unmade.

This truth then can be stated—"eliminate smoke and the coal bill is reduced."

There are on the market today smoke prevention devices. Mind you, I do not say smoke consuming devices, for smoke cannot be burned, the only remedy being to burn all the gases before they become smoke. These devices consist of various mechanical stokers, fire brick arches so arranged as to give longer travel to the hot gases before coming in contact with the cool boiler surface, and during the past few years several makes of firebox boilers, which as a type have proven very successful.

Particularly for heating purposes the firebox boiler, set in brick, has proved itself to be probably the most satisfactory and economical on the market. And the smokeless firebox boiler is the same with the Hawley down-draft furnace, well known to all heating engineers.

The Kewanee Boiler Company, Kewanee, Ill., is the manufacturer of what is commercially known as "The Kewanee Smokeless Firebox Boiler," same being a type of hand-fired, smokeless heating boiler, which is especially deserving of attention. The principle is the one described, a firebox boiler, brick set, and of a Hawley down-draft construction. This boiler is equipped with two sets of grates, upper and lower, the upper grates being water grates. The fresh fuel is fed into the upper grates and the fire on the lower grates is merely that which is maintained by the hot coals which drop down from above. The draft of this boiler is down, the flames and volatile gases passing first thru the fire, the bed of hot coals from the upper grates, then on down and over the hot coals on the lower grates. As fresh air is drawn into and over the lower grate, from the lower draft door, these gases find a fresh supply of hot air awaiting them, which makes it possible to consume all of the gases in the coal.

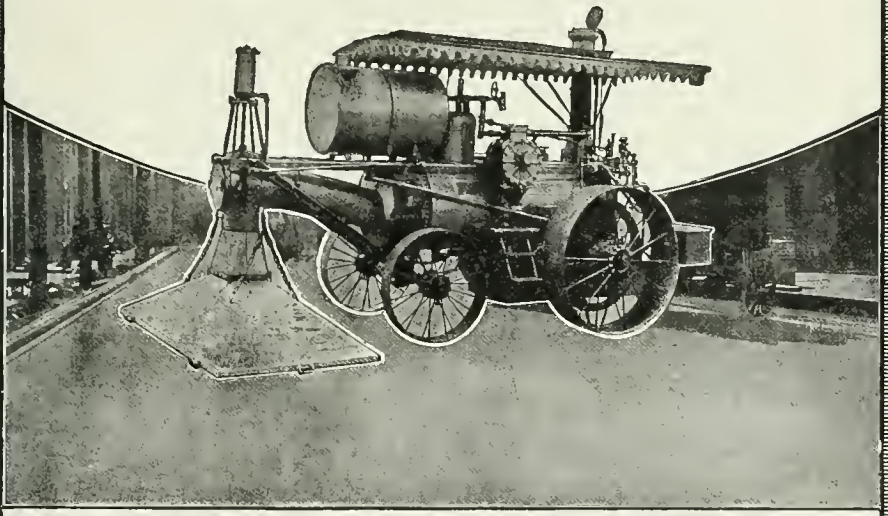
Mechanical Trench Tamping

By W. F. Darling, Superintendent of Streets, Riverside, Cal.

It is my opinion that the time is not far distant when municipalities will require that all back-filling of trenches be mechanically tamped. There is a popular notion that trenches should be allowed to settle for a year before paving and that then they are safe. This is not only a fallacy, which breeds carelessness in cases where it is thought no pavement will be laid in a year or more after all mains and house connections are made and equally impracticable to avoid cutting into pavement for installation of and repairs to service pipes. We all know that by careless or indifferent filling of trenches unpaved streets are often rendered dangerous and nearly impassable for years.

In one instance no trouble developed in the construction of an asphalt pavement laid on concrete foundation, but three years later a horse's hoof broke thru the

Leading Cities are using THE LUTZ SURFACE HEATER in repairing and re-surfacing their old asphalt, brick and stone pavements.



Repairs can be made at a saving of 40 to 50 per cent over the cost of repairing by the old method of chopping up the old pavement and hauling it to the dump.

The Lutz Surface Heater

—gently heats and softens (without flame) old pavements to same consistency as new material. The temperature of both materials being at vulcanizing point, when tamped, smoothed and rolled a perfect weld is produced, leaving a finished surface. Instead of having a "patch" the repair becomes a part of the whole.

Equitable Asphalt Maintenance Co.

Commerce Building. **Kansas City, Mo.**

Illustrated particulars on request.

Nearly all cities have condemned the use of all machines forcing the flame upon the pavement because of the destructive effect of intense heat, and the **Lutz** *method should not be confounded with these destructive appliances. The result of the work done through this principle has been highly satisfactory in every city where it has been used.*

M.E.

surface of the pavement and he broke his leg. Examination revealed a hole six feet deep, which it took fifty loads of earth to fill, over a sewer trench ten years old. It is very common for a pavement to settle a year or more after laying it over a sewer trench, filled several years before the pavement, where no trouble developed during the rolling and laying of the pavement. It is still more common to find almost insurmountable difficulty, while the paving is in progress, from settlement of old trenches. So much for the theory that however carelessly a trench or other fill is made it will settle itself within a year. On the other hand, I have never known of a case where trouble has followed from the settlement of sewer or

STALEY TAMPER, *Riverside, Cal.*

service pipe trenches made immediately before the laying of the pavement where I had supervision of the backfilling, even with treacherous soil conditions.

I would far rather guarantee a pavement laid immediately after a sewer trench, the filling of which I could control and mechanically tamp, than five years after the laying of a sewer, the trench of which was filled with the generally customary carelessness and usual view only to least possible cost.

There is no work connected with public improvements that has a more important bearing on the durability of pavements than the backfilling of trenches, and it is surprising how few engineers understand the proper way of refilling a trench. There are, of course, many soils to cope with, but each must be treated on the same general principle, i. e., to fill all the voids, that in every case all the particles may be as close together and as tightly compacted as possible, and it is my opinion that this result can only be accomplished by mechanical tamping.

We have been operating a Staley power tamper with considerable success, furnished us by the Lourie Mfg. Co., Springfield, Ill. This machine was purchased in November, 1910, and has been in operation almost continually since that date. It has been used principally for tamping back-fill of gas, water and sewer trenches. It easily does the work of eight men and tamps much more compactly than can be done by any hand machine, particularly on improved streets where the dirt has been compacted by heavy rolling. This mechanical tamper does very excellent work in the winter time. We have never had any settlements in trenches tamped by means of this machine nor have the materials to be tamped any effect on the efficiency of the work done.

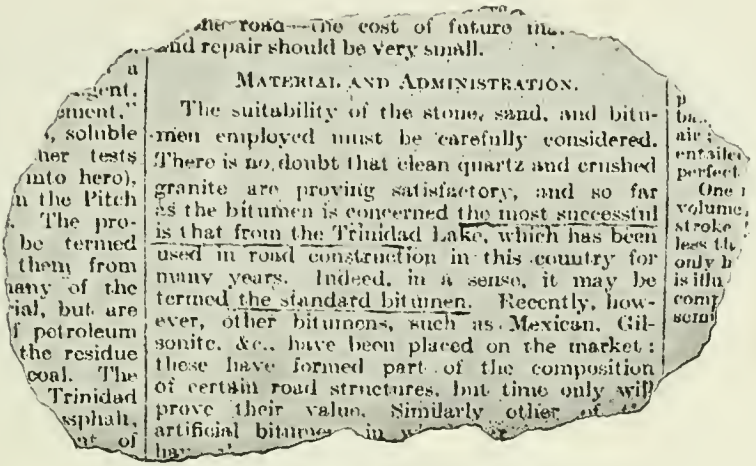
The Staley tamper, in our opinion, not only reduces labor cost of tamping, but is a machine deserving the investigation of every city engineer and street commissioner.

A Portable Loading Machine

A portable loading and screening equipment, designed for reclaiming stone from spent macadam roads, has been satisfactorily and economically used by the Cranford Company, of Brooklyn, for whom it was manufactured by the Link-Belt Company. The machine consists of a bucket elevator, a rotary screen and two chutes, operated by chain and sprocket driven by a 9-h.p. gasoline engine, and the whole mounted on a steel frame work of angle sections supported by four iron wheels. A tongue attached to the axle of the small front wheels allows the machine to be moved by hand or as a trailer to a wagon. A belt-conveyor trailer forms part of the equipment when used on work requiring the machine to be frequently moved. This trailer is a two-wheeled affair with a wagon-like body, the bottom of the body being an endless belt somewhat cupped.

In repaving work the old macadam is first thoroly loosened by plowing. Ten or twelve men with shovels then deposit the old road material in the belt-conveyor trailer attached to the foot of the elevator, which in turn feeds the dirt and stone to the rotary screen at the head. Under the screen are the two chutes, one collecting the dirt and fine material which

Trinidad Liquid Asphalt | **Bermudez Road Asphalt** | **Trinidad Lake Asphalt**



...the road—the cost of future ma... and repair should be very small.

MATERIAL AND ADMINISTRATION.

The suitability of the stone, sand, and bitumen employed must be carefully considered. There is no doubt that clean quartz and crushed granite are proving satisfactory, and so far as the bitumen is concerned the most successful is that from the Trinidad Lake, which has been used in road construction in this country for many years. Indeed, in a sense, it may be termed the standard bitumen. Recently, however, other bitumens, such as Mexican, Gilsonite, &c., have been placed on the market: these have formed part of the composition of certain road structures, but time only will prove their value. Similarly other of artificial bitumen in ...

From Engineering Supplement, London Times.

Trinidad Lake Asphalt

has been used for the construction of something like 170,000,000 square yards of city pavements.

The oldest smooth pavements now in existence after more than a quarter of a century of service are Trinidad pavements.

The pavements showing the lowest maintenance costs for the longest period of life are Trinidad pavements.

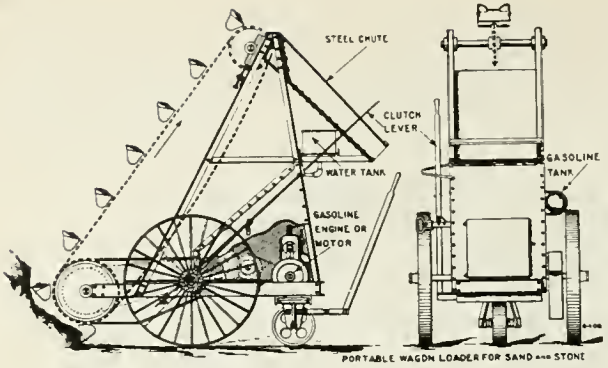
It is not likely that the world's most progressive communities would continue to use Trinidad Lake Sheet Asphalt to an ever-increasing extent if any better type of pavement had been devised, or if any better material was available.

And not only is Trinidad Sheet Asphalt the world's highest paving standard—it is among the lowest in first cost and the most economical in the long run.

Engineers, contractors and taxpayers may well consider these facts in connection with plans for new paving.

The Barber Asphalt Paving Co.

PHILADELPHIA, PENN.



SECTION *of link-belt portable excavator and loading machine.*

is screened out and delivered to carts drawn up along one side of the loader. The other chute collects the clean stone coming off the end of the screen and passes it out the other side of the loader. This stone may again be used for concrete purposes.

One advantage in the use of the loader is that the men shoveling the loosened macadam into the trailer do not have so high a lift as if they were loading it directly into the dump carts. The machine is so arranged that the belt-conveyor trailer at the foot and the rotary screen and the chutes at the head can be taken off the portable elevator frame and a direct chute placed under the head of the elevator, so that the machine can be used for loading concrete materials, such as crushed stone and sand, from storage piles to carts.

The contracting company finds that with three men on the stone pile and a fourth to operate the clutch and control the loading, 2-inch stone can be handled from the ground storage pile to auto trucks at the rate of about 35 tons an hour. This is a saving of about 60 per cent. over the hand-shoveling method, as well as an economy in the time of the truck. The men on the pile use rakes to agitate the stone and keep it flowing to the foot of the elevator, where the buckets pick it up and discharge it to the carts thru the direct chute.

This machine is a development of the Link Belt portable wagon loader, a device which is built by the Link-Belt Company, of Philadelphia, for handling coal, sand, etc., where capacities up to 70 tons an hour could readily be maintained.

Portable wagon loaders of this general type are also rapidly coming into prominence for handling sand and gravel. Because of the fact that this material flows more readily than stone, large capacities can be obtained without increasing the size of the machine.

"This loader easily handles 60 tons per hour," states a leading contractor. "Under actual test we loaded five-ton wagons in five minutes' time and found as an average with the backing up and getting under the loader, that a wagon can be loaded in about six minutes. It usually took us about thirty minutes to do this work with three men.

"We are now using the loader daily and by the use of same have been able to cut down the force in our yard by two men, as these men were only used to load teams with coal we had on the ground.

"You can see from this that the machine is not only a saving to us but also a saving to the companies who are doing the carting, as their wagons are not held up over five or ten minutes in our yards where they were formerly held from one-half to three-quarters of an hour? It is needless to say that we are very much pleased with the machine.

"We are troubled no more with our yard becoming congested with wagons, and the amount that each team can handle a day is increased about 10 per cent. Our statements from the electric company show the cost of power to amount to about one-third of a cent per ton handled.

"We use one man to operate loader and help coal to foot of machine, and the labor of screening is entirely eliminated, as the coal is automatically screened while it is loaded and the breakage of coal around the machine is very little. This fact and the very short time required to load each ton means that the same yard can handle two or three times as much coal, or, looking at it the other way, the yard force can be reduced by about one-half for the same amount of output."

Advantage of Motor Combinations

By Thomas E. Heath, Chief Fire Department, Saskatoon, Sask., Canada.

The two first pieces of motor apparatus installed in this department were two Seagrave combination hose wagons and chemical engines, the six-cylinder, 80-h.p. combination being placed in service September, 1911, and the four-cylinder, 50-h.p. combination being placed in service in February, 1912. We do practically all of our work with these two machines, holding our horse-drawn apparatus in reserve.

The auto combination will make better

Ceresit

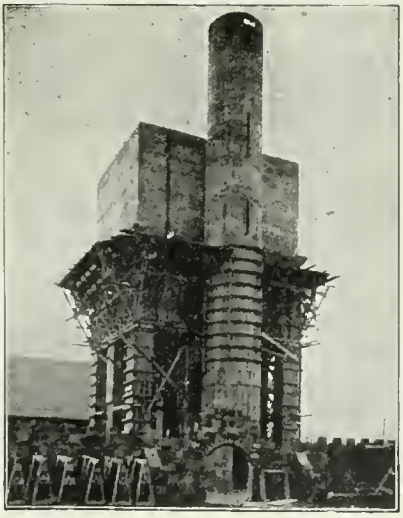
Concrete Ceresitized is Concrete Waterproofed at THE LOWEST COST.

Ceresit is a Cream White Paste which is placed in the water used in mixing the concrete — the water holds the Ceresit in suspension and carries it uniformly throughout the concrete in the mixing process, thus thoroughly waterproofing the entire concrete mass.

Ceresit is specified and used by leading engineers and contractors all over the world for the waterproofing of tunnels, dams, reservoirs, foundations, swimming pools, bridges, water towers, sewers, conduits, viaducts, aqueducts, filtration and septic tanks, drinking fountains, boiler pits, intakes, etc.

There is nothing in Ceresit advertising that is not in Ceresit.

Ceresit
is an *absolute* and *unfailing water repellant* which protects the concrete from disintegration and damage from frosts.



Ceresitized Water Tower, Huntington, N. J.

Ceresit
makes concrete more dense without altering its color or lessening its tensile strength —*requires no scientific mixing machines* and is nominal in cost.

Ceresit Waterproofing Co. 62 W. Adams St. Chicago.

Branches { 1133 Broadway, New York. 1218 Chestnut St., Philadelphia.

Ceresit factories are located in Chicago; Unna, Westphalia, Germany; London; Paris; Vienna; St. Petersburg.

or quicker responses than the horse-drawn in all kinds of conditions of streets or weather. This has been proven many times in all parts of the country. In my city the automobiles were in use and making good runs last winter in from ten to fifteen inches of snow.

As fires are destructive in proportion to the time taken in getting at them, providing the same intelligence is employed in each case, the importance of attacking a fire before it has developed into a bad one is fully recognized by all firemen and also by the insurance interests. It is a well-known fact that the latter require the installation of fire extinguishing apparatus in factories and in other dangerous places, so that fires may be extinguished before a large blaze has developed.

Prompt action is required in the fire service and the auto is and is to be the means of that prompt action.

In most cities using chemical engines or combination chemical and hose wagons, reports state that at least 75 per cent. of the fires are extinguished by chemicals alone. In all probability the general use of the auto comibnation will increase this percentage to 85 or 90 per cent., owing to the speed in arriving at the fire and consequently the more general use of the chemical tank attached.

The auto combination will be a great success in handling brush and grass fires, getting on the job so much quicker than horse-drawn apparatus that the fire is still of no great extent, and so will be handled in much shorter time and apparatus and men returned to station ready for the next run, the auto apparatus making quick returns as well as quick responses.

Looked at from the economical side, there will be a great saving in space occupied, so that new stations may be much smaller, lots purchased may be much smaller, and the total expense will also be correspondingly reduced. Cost of heating and lighting and water bills will be reduced. There will be a saving of one man, as the driver will have no horses to watch and can be used as a fireman in fighting the fire.

We can cover a much larger territory; so, altho we must have enough apparatus and equipment for the very large fires, I think the time will come when more apparatus will be kept as a reserve and possibly a reserve force of men to be called only in time of a very large fire. This would reduce the necessary regular force to quite an extent; especially will this apply to cities up to 75.000 populttion. Cities of over 75,000 may not be able to depend on such a reserve force.

In using horse-drawn apparatus, if a horse falls and breaks a leg, the horse must be shot, but with the automobile, repairs are made and the apparatus is as good as ever; and it is my belief that there will be less failures to arrive in response to alarms with the auto apparatus than with the horse-drawn apparatus.

There are no horses to feed when the machine is not in use and the expense is practically nothing when not actually in service.

The life of auto apparatus has not yet been determined, but it is probable that with good care it will last fully as long as the horse-drawn apparatus.

We have exceedingly bad roads during both spring and fall seasons, but have never stalled our motor-driven combinations. Our winter weather ranges from zero to 50 degrees below, but we have never experienced any engine troubles.

During the past year our apparatus responded to 185 alarms, using 35,750 feet of hose, 901 feet of ladders and 1,553 gallons of chemicals. Time of service in answering these alarms, 116 hours and 37 minutes; distance traveled to and from alarms, 470 miles, 395 yards.

The strength of the department at the present time is composed of the following: One chief engineer, one assistant chief, one engineer of steamer and master mechanic, three captains, three lieutenants, one lineman, thirty privates and one stenographer.

Our 80-h.p. Seagrave motor combination carries 1,000 feet of 2½-inch hose, one 45-gallon chemical cylinder, 150 feet of chemical hose, a full equipment of nozzles and all the other tools required in the service, two short extension ladders. We have one city service hook and ladder truck, carrying from a 60-foot extension ladder down to 12-foot ladders.

The first consideration in getting motor apparatus is to get the necessary strength in all parts in proportion to the strength in horsepower. For instance, if you should purchase a 90-h.p. machine, you should see that the transmission, differential, frame and all parts are built sufficiently strong to withstand the shock to which a 90-h.p. motor would subject them. If this precaution is not followed results may follow such as are experienced when we hitch a team of draft horses to a light vehicle and get stuck in the mud. The team is too strong for the vehicle, and you will soon hear something break.

I expect this fall to install a motor city service truck and also a pumping engine. This pump will be purchased after the convention at New York. We want the best, therefore will inspect the pumping engines at New York and place order for the pump that makes the best showing.

THIS SHIPPING PACKAGE SAVES YOU MONEY

By its use we deliver asphalt with a tare of only 2%.

That means approximately 1,960 net pounds of asphalt to each gross ton shipped.

The drum is easily removed and the asphalt does not stick. Hence —no waste.

Write for proofs of how this package puts money in your pocket.

Standard Asphalt & Rubber Co.,
137 SO. LA SALLE ST.
CHICAGO.

Resurfacing Bituminous Pavements

By Capt. Brook, U. S. A., Assistant Engineer Commissioner, Washington, D. C.

The sum of $425,000 was appropriated for 1912 for resurfacing of old pavements and repairs to improved roadway pavements. This was an increase of $25,000 over the appropriation for the preceding year. The area of sheet asphalt pavements in the District of Columbia is about 3,343,978 square yards, and of asphalt block 648,368 square yards, which is probably a greater area than any other city in the world with the population of the District of Columbia.

During 1912 183,770 square yards of old pavement were replaced, as compared with 183,000 square yards replaced during the preceding fiscal year.

It is believed that the great area of asphalt pavement can be most economically maintained if the average age be retained at about eleven years. This would mean a resurfacing of about one-twenty-second of the entire area in sheet asphalt surface annually. An appropriation of $330,000 for resurfacing and repairs will, it is calculated, after other pavements are maintained, permit the resurfacing of an amount annually that will retain at its present average life the entire amount of street surface that is now in sheet asphalt. Inasmuch as the average age of all sheet asphalt pavements is still in excess of 11 years, an amount is asked for the fiscal year 1914 in excess of $330,000; that is to say, $390,000.

A statement of the resurfacing of pavements in the District of Columbia, by means of the Lutz surface method, for the year 1912 follows:

The prices for resurfacing and repairing asphalt pavements under contract during the year 1913 are as follows:

Laying sheet asphalt pavement (2½ inches asphalt surface, 2-inch binder, before compression), with 6-inch concrete base, per sq. yd.	$1.68
Laying sheet asphalt surface (2½ inches before compression), per sq. yd.	.64
Laying sheet asphalt surface (resurfacing by heater method), per cu. ft.	.66
Laying asphalt binder (in connection with resurfacing work, per cu. ft.	.38
Laying sheet asphalt surface (for repairs and miscellaneous work, cuts, etc.), per cu. ft.	.57
Laying asphalt binder (for repairs and miscellaneous work, cuts, etc.), per cu. ft.	.43
Laying sheet asphalt surface for repairs, etc., within the space required by law to be kept in repair by street railway companies, per cu. ft.	.63
Laying asphalt binder for repairs, etc., within the space required by law to be kept in repair by street railway companies, per cu. ft.	.48

The types of roadway pavements laid during 1912 were the same as in past years—sheet asphalt and asphalt block, with a limited amount of asphaltic macadam. About $150,000 was spent on this last named class of work.

The repair of sheet asphalt pavements by use of the Lutz heater method was continued, about 53,000 square yards being thus repaired during the year. These machines were furnished by the Equitable

Street and Character.	Year laid.	Square yards.	Cost.
A street—Asphalt	1880	2,308	$1,989.93
Corcoran street—Coal tar	1877	2,031	1,413.07
E street—Asphalt	1879	5,186	3,896.64
I street—Asphalt	1886	806	617.76
Massachusetts avenue—Coal tar	1873	3,333	2,708.64
New Jersey avenue—Asphalt	1877	1,557	1,552.42
R street—Coal tar	1889	4,753	3,785.76
First street—Asphalt	1895	1,198	696.96
First street—Asphalt	1893		
First street—Asphalt	1895	6,925	5,346.67
First street—Asphalt	1893		
First street—Asphalt	1895	185	142.56
Third street—Asphalt, bituminous base	1890	4,028	3,101.57
Third street—Scratt coal tar	1875	4,552	3,749.38
Fourth street—Asphalt block	1891	888	681.12
Fifth street—Asphalt	1879	2,058	1,409.76
Sixth street—Asphalt	1880	1,844	1,267.20
Twenty-second street—Asphalt	1895	2,204	1,666.51
Twenty-fifth street—Asphalt, bituminous base	1890	1,625	1,219.68
Thirty-third street—Asphalt	1883	1,090	887.52
Thirty-fifth street—Asphalt, bituminous base	1890	6,068	4,260.96
Totals		52,639	$40,394.11

BOSTON

The Pioneer in Creosoted Yellow Pine Block Paving.

Unbiased statements of Engineers who superintend the construction of streets are dependable and absolute authority from every standpoint.

Tremont Street, near Temple, Boston, Mass. Laid in 1900—Southern Long Leaf Yellow Pine.
This street is heavily traveled and in excellent condition today, having cost practically nothing for repairs.

"I consider a treated **Long Leaf Yellow Pine** block suitable for any traffic; blocks that have been under wear for thirteen years are apparently as serviceable as ever — the maintenance of our wood block paving has not cost the contractors or the city anything during the past twelve years, nor do we look for any outlay in the immediate future, judging from present conditions.

"The streets that receive the heaviest traffic in Boston are paved with Southern Yellow Pine Creosoted Blocks, also some of the finest resident sections. The pavement is highly satisfactory and economical in each location in every sense of the word for both heavy and light traffic streets."

MR. JAS. H. SULLIVAN, Division Engineer,
Board of Public Works, City of Boston.

MR. ENGINEER: Yellow Pine Creosoted Blocks give the property owner and city official better paving value for money expended than any other kind of paving material. **Use It**—The city must pay for all repairs. The absence of "necessary repairs" with Creosoted Yellow Pine wood blocks makes it possible to construct *new pavements*—a much better record than a constant financial drain for semi-annual repairs (and then some) on less durable pavements.

Write for literature and information

Yellow Pine Manufacturers' Association

711 Wright Building
ST. LOUIS, MO.

Asphalt and Maintenance Company, Kansas City, Mo.

The Lutz method consists in drawing a large volume of air, heated to the proper temperature, from a heating chamber and blowing it with great force upon the asphalt or other bituminous pavement, thereby gently heating and softening without flame the old pavement to the same consistency as the new material. Then with the use of hoe and rake all disintegrated materials, uneven or worn surfaces are removed and joints cut, and while the pavement is still hot sufficient new material to bring up the grade and contour of the street is added. The temperature of both materials being at the vulcanizing point, when tamped, smoothed and rolled a perfect weld is produced, leaving a finished surface. Instead of having a patch, the repair becomes a part of the whole.

Bitulithic for New York State Highways

The New York State Legislature inserted in the state highway laws this year a provision that "in the construction, maintenance or repair of state or county highways, no patented material or article or any other material or article shall be specified contracted for or purchased, except under such circumstances that there can be fair and reasonable opportunity for competition, the conditions to secure which shall be prescribed by the commissioner of highways."

On July 22, 1913, State Highway Commissioner John N. Carlisle, adopted rules of competition for bitulithic patented pavement, providing that upon the owners of bitulithic pavement patented by Warren Brothers Company, of Boston, Mass., complying with the following requirements, the use of their pavement is permitted in the State of New York until further order of the commission.

Upon the commissioner of highways determining that any pavement in any city or village on any county or state highway in the State of New York shall be constructed of bitulithic pavement, the owners of said patent, within five days thereafter, shall file with the state highway department at their office in the city of Albany, N. Y., a price at which they will deliver said material to contractors in connection with said work to be constructed or improved. Said price to be available for any contractor desiring to bid upon said work and the provisions of the offer of said company to be approved by the State Department of Highways."

The villages of Lowville, Oriskany Falls and Ilion and the cities of Johnstown, Rome and Whitesboro have petitioned for the laying of bitulithic on state highways running thru these municipalities under Section 137 of the New York State Highway Laws.

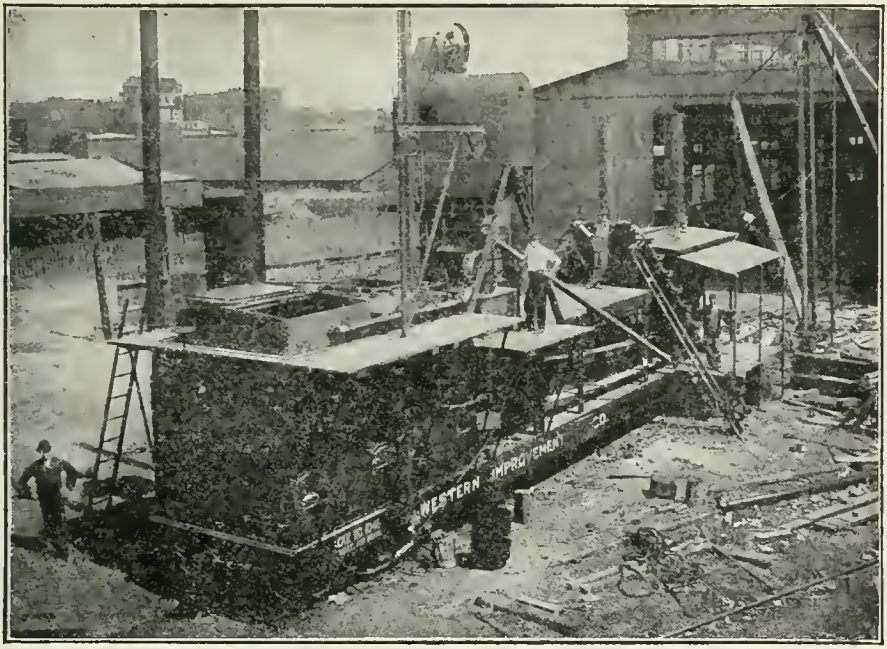
Economy of Traction Hauling on Gatchellville Road, York County, Pa.

By John F. Hammond, General Engineer.

In building this road nearly 14,000 tons of 2-inch stone were required, and owing to the inaccessibility of the location and the prohibitive grades from other nearer depots, all the stone had to be hauled from York, at nearly the southern end of the route; and because of these grades, team hauling was exceedingly expensive and slow, as a team of average weight usually found among the farmers could not move over two tons per day for a wage of $3.50, or $1.75 a ton. The grades of the finished road were approximately 7 per cent. on some of the hills for a considerable distance. The records on which this article is based were started on August 1, 1912, after two miles, one-half of the road, had been built, and continued up to November 14, 1912, when the road was completed. These records were kept as a means of information and to promote efficiency by compelling daily report of the materials used, wages paid and work done.

We pumped directly from a barrel sunken in the bed of a brook into a large tank placed on the roadside, high enough to fill the engine tanks by gravity, but made the mistake of not having our outlet from the large tank of sufficient size to fill our engine tanks as quickly as we might have done, and delays occurred at the tank that were needless and annoying. Water was pumped into the supply tank by a small 1-cylinder gasoline pump, which operated very cheaply, and only required the services of the engine driver to start and stop it as he passed on his trips. The wages paid to the engine crew were: Engineer, $3.50 per day; fireman, $1.75 per day, steady time for ten hours daily; overtime at same hourly rate. The fireman operated the stone-spreading cars, making the spread of even thickness, which requires considerable experience and should be closely watched by the overseer, as the tendency is to spread too deeply and superfluous stone would have to be removed at an extra expense. Supervision in our case was figured at one-third of the superintendent's time, or $2.28 per day with no extra time allowance. Interest and depreciation are figured on the new value of the machinery and on an estimated

MODEL OF 1912 ONE-CAR PLANT.



1,000 SQUARE YARDS 2-INCH TOPPING PER DAY.

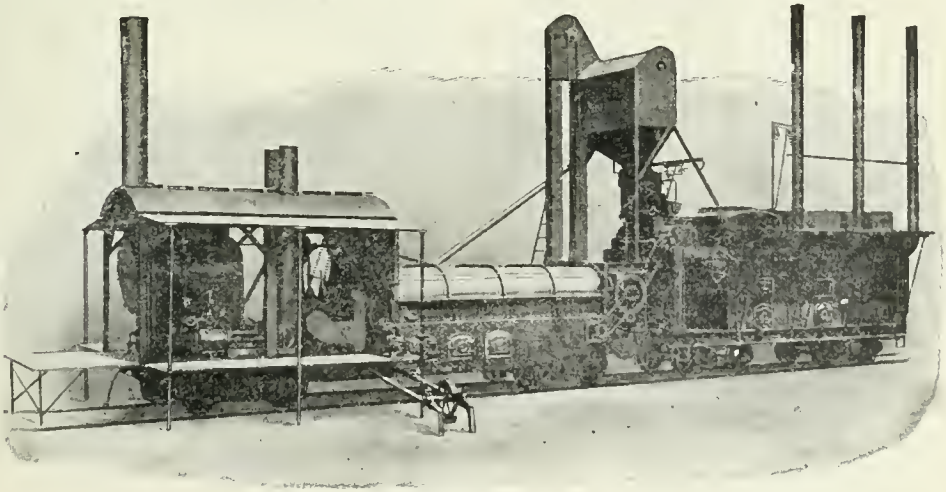
HETHERINGTON RAILWAY ASPHALT PAVING PLANTS

The product of 16 years experience in Plant Building by the originators of the first railway plant. **Still lead, are only safe railway plants made.**

THESE PLANTS HAVE NO EQUALS. WRITE FOR CIRCULARS.

HETHERINGTON & BERNER, - INDIANAPOLIS. IND.

1,500 SQUARE YARDS AND 2,000 SQUARE YARDS PER DAY.



MODEL OF 1912 TWO-CAR PLANT.

HUBER TRACTOR *hauling stone for road construction.*

life of four years, or 25 per cent. depreciation per year, with an interest charge on the capital invested of 5 per cent. The sum of the interest and depreciation, however, are figured for the whole year and divided into the days that we actually worked. This is hardly fair to the machine, as it might have done more days' work and thus reduced this item.

The following tabulations show our conclusions and we think may be considered quite accurate. I have not thought it necessary to make an analysis of the repair account, which consisted of castings, bolts, nuts, valves, pipe elbows, engineer's and fireman's time and many small items.

Total Cost of Operation—93 days.

Operating	$ 945.67
Repairs	310.17
Depreciation and interest	686.15
Supervision	239.40
Total	$ 2,181.39

Analysis of Operating Account.

4.70 tons coal at $4.50	$ 21.15
3.49 tons coal at $5.00	17.45
913.4 tons coal at $3.26	297.77
Water	66.27
67 gal, cylinder oil at 30 cents	20.10
30½ gals. black oil, at 9½ cents.	2.94
333½ pounds grease at 5½ cents	18.77
71 lbs. waste at 7½ cents	5.35
Engineer's wages on operation	330.41
Fireman's wages on operation	164.83
3½ gals. kerosene at 10 cents	.35
1 can of tar at 28 cents	.28
Total	$ 945.67

Daily Expense.

Supervisor's wages	$2.28
Engineer's wages	3.50
Fireman's wages	1.75
Coal	3.55
Cylinder oil	.21
Black oil (gears)	.03
Grease (cups and gears)	.20
Kerosene	.003
Tar	.002
Waste	.06
Depreciation	6.417
Interest	.961
Repairs	3.33
Total	$22.293

Tonnage Hauled.

August 1, 1910	1,681
September 1, 1910	1,525
October 1, 1910	1,176
November 14, 1910	284
Total tons	4,666

Cost Per Ton Hauled.

Operation	$945.67÷4,666=$0.202
Repair	310.17÷4,666= 0.066
Depreciation	596.78÷4,666= 0.128
Interest	89.37÷4,666= 0.017
Supervision	239.40÷4,666= 0.051
	$0.464

Extreme haul, 9.44 miles. Start, 5 miles. Average length of haul, 7.22 miles round trip; 2.24 trips daily; 209 trips, or 1,508.98 miles in 93 days.

Adaptability of Small Mixer

By J. H. Powers. Powers-Snyder Co., Contractors, Binghamton, N. Y.

Placing concrete by means of the hoisting tower and chutes, a method which has lately come into wide use, is economical only on operations of very considerable size. On residence work, silos, and other structures requiring only comparatively small volumes of concrete, the tower and chute equipment and its operation involve prohibitive expense. We have adopted the use of concrete mixers equipped with a quick-acting hoist, connected direct to the engine, making a complete, compact outfit, which is easily and profitably used wherever concrete has to be not only mixed, but hoisted into place. This hoist consists of two standards sup-

The Merger of East and West

"But there is neither East nor West, Border, nor Breed, nor Birth,
When two strong men stand face to face, tho' they come from the ends of the earth!"
—KIPLING.

In the "Ballad of East and West," Kipling tells the story of an Indian border bandit pursued to his hiding place in the hills by an English colonel's son.

These men were of different races and represented widely different ideas of life. But, as they came face to face, each found in the other elements of character which made them friends.

In this country, before the days of the telephone, infrequent and indirect communication tended to keep the people of the various sections separated and apart.

The telephone, by making communication quick and direct, has been a great cementing force. It has broken down the barriers of distance. It has made us a homogeneous people.

The Bell System, with its 7,500,000 telephones connecting the east and the west, the north and the south, makes one great neighborhood of the whole country.

It brings us together 27,000,000 times a day, and thus develops our common interests, facilitates our commercial dealings and promotes the patriotism of the people.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

porting the drum and main gear; the driving pinion is attached to the friction drive, which is in turn attached to the engine.

We find that this method enables us to elevate concrete at lowest cost. We hoist three buckets of concrete at a time no matter whether mixer is full of concrete or not. The machine used in this work, which is furnished by the Jaeger Machine Co., Columbus, Ohio, is equipped with a 2½-h.p. engine. The hoist lifts 300 pounds easily over a common block at the rate of 60 to 80 feet per minute with both hoist and mixer operating at same time or singly, at a cost of approximately 4½ cents per hour for gasoline. This machine, which has a drum capacity of two wheelbarrow loads, is operated and easily moved on the job by two, three or four men who will accomplish several times the work that can be done by the same number of men mixing by hand. The simple, compact design with no charging device makes it ready for operation the moment it arrives on the job, and it is frequently possible to have a large part of the concrete in place with this machine before a cumbersome mixer with a charging elevator could be set up ready for operation. It is built especially for sidewalk, curb and gutter construction, for small sewers and house foundations, mixing cement mortar, making cement blocks and for concrete floors, small bridges and culverts; in fact doing all the mixing of the average contractor and builder.

Obtaining the proper proportions does not guarantee first class concrete. Proper mixing counts for much. The sand and cement should be first mixed dry and then mixed wet into a homogeneous mortar. The coarse aggregate, previously drenched, should be added to this mortar, and all thoroly mixed together. This practice can be followed in either hand or machine mixing, provided a batch mixer is used. On small work, hand mixing is no longer the most popular. It is our opinion that the job so small that a small mixer cannot be employed to advantage is not worth considering. Oftentimes mixing is sorely neglected, being intrusted without proper supervision to laborers who have little appreciation of what is really necessary and less interest in final results. Machine mixing on the smallest jobs, when the batch type of mixer is used, is much more certain and reliable than hand mixing.

Generally speaking, wet concrete will give better results than dry, and tho it is not practicable to use as wet concrete in sidewalk construction as in some other classes of work, the concrete should be mixed with as much water as it will stand and permit of thoro tamping. Probably all who have had anything to do with mixing concrete by hand have noticed that the mass becomes more moist as the mixing progresses. This is because the particles are being forced into closer contact, and indicates that the object of the mixing is being accomplished. The same plasticity is apparently obtained by the use of an excess of water and less mixing. This does not give the same results and should never be substituted for thoro mixing. The mixing should always be conducted in a manner which will not permit of the loss of cement thru the running off of surplus water.

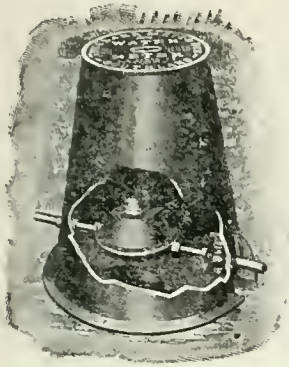
A sack of cement has a net weight of 94 pounds, and can be considered in volume as equal to 1 cubic foot, which greatly simplifies proportioning.

Concrete is no stronger than its aggregate. It makes no difference how well the cement may test, if the gravel, sand or stone does not possess the necessary requisites, the job will be a failure. Good appearing sand or gravel will sometimes develop characteristics which may disfigure and even destroy the work into which it enters. Quite often, shaly pebbles which are not noticeable except under careful scrutiny will, when used in the concrete, disintegrate, and in so doing expand, breaking out large pieces of top mortar. When such particles occur in the sand, the disintegration gives the whole surface a pitted appearance, disfiguring the work. Clay is also detrimental when occurring as a coating on the particles, and in many places it is absolutely necessary to provide a washing apparatus, which will remove it. Many installations of commercial types of washers are in satisfactory use. However, by spreading the material out on a loose board platform in small quantities and turning on a stream from a ¾-inch garden hose, very satisfactory results have been obtained. When the job is not too large, this same process can be applied to the washing of the sand.

It is our contention that our type of mixer is most economical on all jobs, no matter what the size of the work. Before the purchase of our mixer, we, of course, did all hand mixing and the comparison of costs is interesting. By the use of hand mixing the average yardage secured per man, including everybody in the organization, was 2.31 cubic yards, as against 3.83 cubic yards secured by machine mixing. Including only those actually engaged in mixing and depositing concrete, the average was 3.04 cubic yards for machine mixing. In arriving at the machine figure, the three men operating the machine were included, since they replace the mixers on the boards. In the latter figure, the foreman, the finisher and his helper and the form setter were not included.

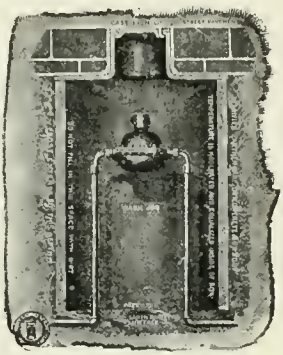
CLARK METER BOXES

THE "SOUTHLAND"



are manufactured in sizes and shapes to properly house any kind or size of water meter, whether it is to be installed in the frigid north or the torrid south.—We would like to tell you more here about the largest and most complete line of water meter boxes manufactured—but space does not permit.—Our catalog is yours for the asking.—State depth of service and number of meters to be installed during the year—and we will do the rest.

THE "NORTHLAND"



The Box Body, quite often made of concrete in our well-known Iron Collapsible Form, reduces the "first cost" to the minimum. The **"Clark Meter Box"** may be used with or without the cast iron base.

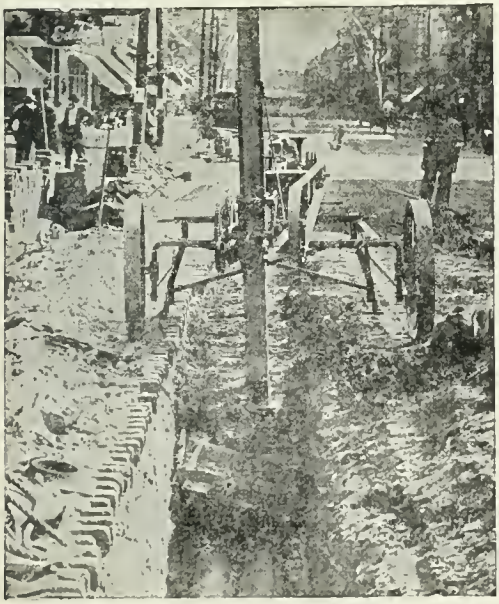
In extremely wet localities, the base assures perfect watertightness.

"TEKSAGON" Meter Couplings require no Gaskets, therefore eliminate leaks, choked waterways, and reduce meter maintenance. You should use them on all of your Meters.

H. W. CLARK CO. 1512 Broadway **Mattoon, Ill., U.S.A.**

Manufacturers of Water Meter Boxes for Every Meter—Valve Boxes—Roadway Covers—Collapsible Forms for making Concrete Meter Box Bodies and Tile—Meter Couplings—Gauges—Deep Well Constructions, Pump Plungers; Etc.

Staley Power Tamping Machine



saves eight out of ten men

Pavements can follow immediately over trenches that have been tamped by this machine without danger of future depression.

—Straddles any width trench up to 4 feet.

—Eighty-five pound, 8x8 inches, tamp strikes 56 blows per minute at any point at any level from one to six feet below surface.

—Pounds dirt into solid, compact mass from bottom to top of backfill, thus obviating all sinking of trenches and consequent pavement repairs.

—Pavements can be immediately laid over **Staley tamped** trenches without any danger of further depressions.

—Can be used for tamping sidewalk paving, sewer and concrete construction.

—Special attachments for cutting asphalt and concrete pavements.

No more sinking of trenches if Staley Tampers are used.

Write for Proposition, Complete Information and Prices.

Lourie Mfg. Co.

SPRINGFIELD, ILLINOIS.

CONTRACTING NEWS

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Bluffton, Ind.—Sept. 18, until 10 a. m., for the construction of a gravel road on county line between Wells and Grant counties. L. A. Williams, auditor Wells county; E. H. Kimball, auditor Grant county.

Chicago, Ill.—Sept. 11, until noon, for excavation and collateral work on Section 9 of the Calumet-Sag channel. The approximate quantities to be used in comparison of proposals are: (a) 875,000 cubic yards of excavation of glacial drift, (b) 50,000 cubic yards of excavation of solid rock, (c) 70,000 square yards of rip-rap slopes, (d) 1,750 lineal feet of roadway construction, (e) 1,100 cubic yards of No. 1 concrete, (f) 1,350 cubic yards of No. 2 concrete, (g) 90,000 pounds of reinforcing metal. Thomas A. Smith, president board of trustees of Sanitary District of Chicago.

Cincinnati, O.—Sept. 12, until noon, for the following county work: Under Specification No. 132 for the improvement of the Banning road, from corporation line of Mt. Airy to Blue Rock pike in Colerain township; certified check, $2,000. Under Specification No. 515 for the improvement of the Ohio pike, from Station 79 to Bogart road in Anderson township; certified check, 1,000. Albert Reinhardt, clerk board of Hamilton county commissioners.

Cincinnati, O.—Sept. 5, until noon, for the following county work: Under Specification No. 536 for the improvement of Evendale road, from Chr. Jentz's mail box at Stop 41 on Madison avenue in Sycamore township; certified check, $2,000. Albert Reinhardt, clerk Hamilton county commissioners.

Columbus, O.—Sept. 5, until noon, for furnishing all the labor and material necessary to construct, build and complete the following work: Engineer's estimate No. 477 for improving and macadamizing the Atchenson road in Clinton and Mifflin townships; engineer's estimate No. 510 for constructing the Waterman road in Franklin township; engineer's estimate No. 515 for repairs on Greenlawn avenue, between the Scioto river and the Jackson pike, Franklin township; engineer's estimate No. 524, Plan B, for constructing the west approach on the Wilson bridge over the Olentangy river, Sharon township; engineer's estimate No. 534 for furnishing, hauling and spreading crushed limestone and screenings on the road west of the Olentangy river, north and south of Lane avenue, and on Lane avenue just west of the River road in Clinton township. Each and every bid shall be accompanied by a certified check, payable to the order of the board of county commissioners, or cash in the sum of $200 on estimates Nos. 515 and 524. The work comprised in estimates Nos. 477, 510 and 515 shall be fully completed on or before the first day of December, 1913. The work comprised in estimate No. 534 shall be fully completed on or before the first day of November, 1913. The work comprised in estimate No. 524 shall be fully completed on or before the first day of July, 1914. Upon failure to complete the work within the time specified, the contractor or contractors shall forfeit to the county of Franklin the sum of $10 a day for each and every day that may elapse between the time specified for the completion of work and the final completion. John Scott, clerk board of Franklin county commissioners.

Columbus, O.—Sept. 5, until 10 a. m., for grading and paving with concrete the Ohio River road in Marietta township, Washington county. Length, 6,700 feet, or 1.27 miles; width of pavement, 16 feet. Estimated cost, $16,479.30. Certified check, $300. Bond, 150 per cent. of contract price. Date of completion, August 1, 1914. James R. Marker, state highway commissioner.

Columbus, O.—Sept. 5, until 10 a. m., for grading and paving with brick for heavy traffic, the McConnelsville-New Lexington road, in Malta and Deerfield townships, Morgan county. Length, 6,000 feet, or 1.14 miles; width of pavement, 12 feet. Estimated cost, $22,647.20. Certified check, $300. Bond, 150 per cent. of contract price. Date of completion, August 1, 1914. James R. Marker, state highway commissioner.

Columbus, O.—Sept. 15, until 10 a. m., for grading and paving with water-bound macadam, the following roads: The Pomeroy-Jackson road, Lick township, Jackson county; length, 18,000 feet, or 3.41 miles; width of pavement, 12 feet; estimated cost, $13,290; certified check, 300; bond, 150 per cent. of contract price; date of completion, August 1, 1914. The Steuenbville-Cambridge road, in Moorefield township, Harrison county; length, 6,600 feet, or 1.25 miles; width of pavement, 12 feet; estimated cost, $9,464; certified check, $300; bond, 150 per cent. of contract price; date of completion, August 1, 1914. The Milan-Elyria road, in Milan township, Erie county; length, one mile;; width of pavement, 12 feet; estimated cost, $5,546.60; certified check, $300; bond, 150 per cent. of contract price; date of completion, August 1, 1914. The Cleveland-Sandusky road, in Huron township, Erie county; length, 7,920 feet, or 1.50 miles; width of pavement, 12 feet; certified check, $300; bond, 150 per cent. of contract price; date of completion, August 1, 1914. James R. Marker.

Columbus, Ind.—Until Sept. 8, for the paving of Second street, from the White river bridge to the Haw creek bridge; for making the fill on the low part of Second street, and for building an 84-foot extension to the Haw creek bridge. Time allowed for completion, one year. Estimated cost of work, $30,000. Wm. H. Rights, city engineer.

Danville, Ind.—Sept. 8, until 10 a. m., for the construction of a road in Middle township, Hendricks county. Lewis W. Borders, auditor.

Dodge City, Kans.—Sept. 5, until 6 p. m., for construction of Third avenue brick pavement on concrete base, in paving district No. 1, consisting of approximately 12,800 square yards, together with the necessary excavation, curbs, gutters and appurtences. Certified check, $1,000, drawn on some local bank. W. E. Baldry, city engineer; S. Gallagher, city clerk.

Jonesboro, Ark.—Until Sept. 7, for furnishing labor and material for laying approximately 10,000 square yards of brick pavement, including drainage and curbing. B. H. Berger, secretary of board of commissioners for street improvement district No. 10.

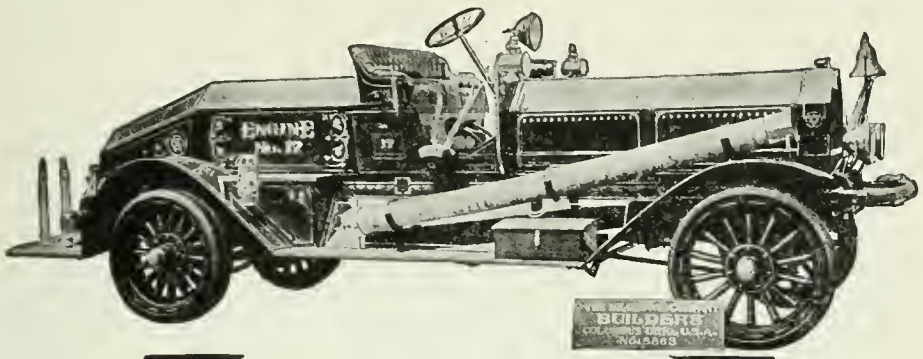
Lake Charles, La.—This city is now advertising for bids for about 85,000 yards of street paving. For further information, address G. L. Riling, mayor.

New Orleans, La.—Sept. 8, until noon, for the construction of a public highway, between Mansfield and Benson in DeSoto Parish, a distance of 12 miles. W. E. Atkinson, state highway engineer, room 104, New Orleans Court building.

CONTRACTS AWARDED.

Bloomfield, N. J.—The Standard Bitu-

Multi-Stage-Centrifugal Pumping Engine



1000 Gallons per minute at 120 lbs. Pump Pressure
600 Gallons per minute at 200 lbs. Pump Pressure

SEAGRAVE

Built in two sizes, 750 and 1000 gallons capacity per minute at 120 lbs. Pump Pressure and can be furnished with or without hose body and chemical tanks, as desired.

Delivers More Gallons Per Minute at Higher Pressure than Any Other Pumping Engine in the World

No wearing parts — **No springs**
No relief valves — **No vibration**
Slow speed motor — **High efficiency**

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Watch our Competitors Follow Our Lead.

THE SEAGRAVE COMPANY

COLUMBUS, OHIO

lithic Co., of Newark, N. J., was awarded the contract for paving Dodd street. Contract price, $6,373.16.

Cadiz, O.—Contract for brick paving has been awarded to Herman Coss and A. C. Meyer, of Wheeling, W. Va., at $24,059.

Canton, O.—The paving of the Canton-Massillon highway has been awarded to the Campbell-Downs Construction Co., of this city. Bid, $36,034.

Hiawatha, Kans.—The Chopin Construction Co., of Kansas City, Mo., was awarded the contract for construction of 12,000 square yards of Dolarway pavement.

Iowa Falls, Ia.—The Dearborn Construction Co. has been awarded the contract for the additional paving at Eldora.

Leon, Ia.—Contract for paving, to be done in Leon this summer, was awarded to Ford Paving Co., of Cedar Rapids, bid being $79,962.28.

Marshall, Mo.—13,000 square yards of Dolarway paving has been awarded J. M. Clark, of Nevada, Mo., at bid of $1.43.

Memphis, Tenn.—L. W. Johnson has been awarded 5,000 square yards of Dolarway paving at bid of $1.33, and H. B. Fowler 10,000 square yards of same at $1.29. Both are local contractors.

Monroe, Wash.—Pugh & Arenz, of Salem, Ore., were awarded the contract for paving Madison, West Main and East Main streets with Portland cement concrete, about 13,509 square yards, at cost of $20,485.

Pittsburgh, Pa.—Contracts for city improvements were awarded as follows: Repaving (wood and block stone) South Main street, to Thomas Cronin Co., at $5,225.75; (with asphalt) Sheffield street, to Booth & Flinn, Ltd., at $1,082.28; cement sidewalks, approach to Stieren street bridge, to Wadsworth Stone Paving Co., at $1,190.40; West Carson street, to Griffith Concrete and Construction Co., at $1,500.83; retaining walls, South Eighteenth street, to W. J. Payne, Jr., Co., at $1,678; Chislett street, to M. D'Herron Co., at $9,100.25. All are local firms.

Rahway, N. J.—Contract for paving with asphalt block on Irving street has been awarded to Hastings Paving Co., of New York City, at $24,250.

Rochester, N. Y.—Contracts have been awarded by board of contract and supply for paving with wood block Genesee street, and with asphalt Troup street, to Whitmore, Rauber & Vicinus, 279 South avenue, at $108,950 and $19,332, respectively.

Salt Lake City, Utah—Contract for paving Seventh South street and Fifth South street has been awarded to I. J. Moran, 152 West Second South street, at $60,105.

San Francisco, Cal.—G. W. McGinn & Co., Phelan building, were awarded the contract for paving with asphalt San Bruno avenue. Contract price, $16,000.

SEWERS.

Queens Boro, New York City.—Bids are now being advertised for the construction of an outlet trunk sewer to drain 6,000 acres or 78,000 city lots. The district, which it is predicted will ultimately contain a population of a million, includes sections now in a state of development. In the large area are developments in Elmhurst, Winfield, Woodside, Maspeth, Astoria, North Beach, Forest Hills, and others on the border line between the Fourth ward and Kings. According to estimates of the engineers of of the board of estimate and the Queens sewer bureau, the trunk sewer will cost $1,145,790. Inasmuch as in certain sections the trunk sewer will be from 90 to 100 feet below the present surface grade, tunnelling operations will be resorted to in the construction of the sewer. Maurice E. Connolly, president of boro.

Spencer, Ia.—Sept. 5, until 8 p. m., for the construction of sewers as follows: Beginning in the present Main street sewer at the intersection of Main and River streets, and running east along the center line of East River street, a distance of 872 feet, there terminating. Maximum depth of sewer, 9.75 feet; minimum depth, 7.25 feet; average depth, 8.5 feet; said sewer to be provided with 32-inch "Y" connections, four catch basins, and two manholes. Sewer to be constructed of 8-inch glazed, first quality vitrified sewer pipe, solidly cemented at the joints, approved covers to be provided for the manholes and catch basins, and to be completed within 60 days of time of letting. Certified check for $100, payable to E. Taggart, city treasurer; Etta M. Smith, city clerk.

CONTRACTS AWARDED.

Great Falls, Mont.—Contracts have been made with the following firms for sewer work in various districts: Nilson-Smith Co., Great Falls, $4,400; Hanlon & Oaks, Sioux City, Ia., $13,750; F. E. Evans Contracting Co., Great Falls, $6,100.

Linton, Ore.—The James Kennedy Construction Co., of Portland, Ore., was awarded the contract for the construction of a complete sewerage system.

Mason City, Ia.—S. R. Bowen, a local contractor, was awarded the contract for constructing a sanitary sewer on East Drummond street. His bid was as follows: Seventy-five cents per cubic yard earth excavation and back filling; $2.25 per cubic yard loose rock excavation and back filling; $5.50 per cubic yard hard rock excavation and back filling; 25 cents per foot for 8-inch pipe furnished and laid; $1.25 additional for 6 or 8-inch Y branch, $1.50 manhole complete. F. P. Wilson, engineer.

CONTEMPLATED WORK.

Carthage, Mo.—The building of a main sewer leading from the corner of Main street and St. Louis avenue to a point on Spring river, a distance of about 3 miles, is being considered. Estimated cost, $24,107.75. Frank Newton, city engineer.

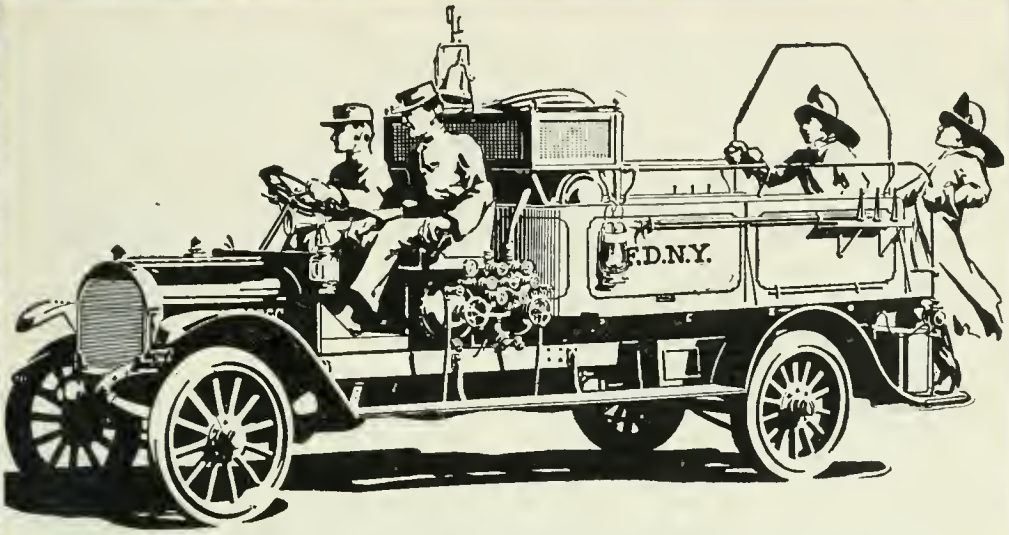
Indianapolis, Ind.—Plans for the construction of sewers in the following streets have been adopted by the board of public works: Rookwood avenue from Fortieth to Forty-fourth street; alley east of Applegate street, from Legrande avenue to Raymond street; Senate avenue, from Fortieth to Forty-fourth street; Burdsal parkway, from Schurmann avenue to Belt railway tracks; Adelaide street from New York to Ohio street; Bolton avenue, from Julian avenue to a point 262 feet south; Gladstone avenue, from St. Clair street to a point 520 feet north; Langley avenue, from Roosevelt avenue to Hazel street; alley west of Olney street, from Twentieth to Twenty-first street, and alley north of Twenty-fifth street, from Clifton to Annetta street.

Waterloo, Ia.—The village board has adopted a motion providing work on the sanitary sewer system to be started at once. The system will consist of 14 miles of 6 and 20-inch pipe sewer, 400 feet double 14-inch siphon under the Seneca river, septic tank, sludge beds and pumping station. C. A. Roby, engineer.

WATER WORKS.

BIDS REQUESTED.

Baltimore, Md.—Sept. 10, until 11 a. m., for furnishing and erecting pumping machinery and filtration plant, Water Department Contract No. 19. Plans and specifications can be obtained at the office of Ezra B. Whitman, the water engineer, City Hall, Baltimore. A charge of $5.00 will be made for each set of plans and specifications. The extent of the work is as follows: One



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MACK and SAURER

NEW YORK CITY RE-ORDERS
INTERNATIONAL APPARATUS

Every city official should know how Greater New York City secured dependable fire apparatus. You should write us for a copy of the New York specifications. They cover every essential detail of motor and fire apparatus construction.

Of all the competing high pressure trucks, ours were the only ones that met the specifications and stood the tests.

Contracts were awarded for 33 pieces of our apparatus. On delivery each of these was rigidly checked against the specifications. Then the apparatus was subjected to the heavy and exacting test run. Each of the 33 pieces readily passed the inspection and tests.

Now after months of actual service with International apparatus, the Purchasing Board has re-ordered ten more International High Pressure Trucks.

The history of this award will be of great value to you. We will gladly furnish the data upon request.

Write today.

INTERNATIONAL MOTOR COMPANY

General Offices, Broadway and 57th St. **NEW YORK CITY.**

horizontal centrifugal pump of 35,000 gallons capacity, two horizontal centrifugal pumps of 28,000 gallons capacity; one horizontal centrifugal pump of 21,000 gallons capacity; one 2-stage underwriters' pump of 750 gallons capacity; three vertical centrifugal pumps of 4,000 gallons capacity; two vertical centrifugal (Sump) pumps of 200 gallons capacity; two vacuum pumps; placing, piping and valves.

Baltimore, Md.—Sept. 10, until 11 a. m., for furnishing and erecting electric power equipment for filtration plant, Contract No. 20, water department. Plans and specifications can be obtained at the office of Ezra B. Whitman, the water engineer, City Hall, Baltimore. A charge of $5.00 will be made for each set of plans and specifications; this amount will be refunded. The extent of the work is approximately as follows: For furnishing and erecting four 400-K.v.a. transformers, one 50-K.v.a. transformers, circuit breakers and high tension switchboard, one 9-panel low tension switchboard. All wiring and starters for connecting up various motors; for furnishing the following motors: One 400-h.p. motor; two 350-h.p. motors; one 250-h.p. motor; one 75-h.p. motor; three 50-h.p. motors.

Jacksonville, Fla.—Sept. 15, until 10 a. m., for furnishing and erecting complete, at the water works, on foundation to be provided by city, one high duty horizontal cross compound or triple expansion condensing pumping engine, together with all necesary appurtenances, guaranteed duty to be not less than 135 million foot-pounds per 1,000 pounds of dry steam, and to have a capacity of twelve million gallons in 24 hours against a total dynamic head of 170 feet when pumping into mains for domestic use and be able to pump the same quantity against a dynamic head of 270 feet for fire service with a steam pressure of 145 pounds at the throttle. As an alternative proposition prices are requested also for an engine of same general design having a capacity of fifteen million gallons in 24 hours. For specifications in detail and other information, apply to E. L. Carroll, superintendent waterworks, Engineering building, Jacksonville, Fla. Envelopes containing bids should be addressed to the chairman of the board and each be plainly marked as a bid on waterworks pump. The board reserves the right to reject any and all bids. W. M. Bostwick, Jr., chairman.

Taylorvile, Ill.—Sept. 8, until 1 p. m., for the following waterworks equipment: One high duty, compound, condensing, duplex, direct acting, 750,000 gallons daily capacity; four deep well pumps complete; four small brick houses for deep well pumps; two boilers, 100-h.p. each; one stack, 42 inches diameter, 60 feet high; putting concrete lining in brick well, steam piping water connections for pump and boilers. Plans and specifications are in the office of the city clerk or in the office of Hiram Phillips, consulting engineer, 716 International Life building, St. Louis, Mo.

BRIDGES.

BIDS REQUESTED.

Bowling Green, O.—Sept. 8, until 2 p. m., for furnishing the labor and material for construction of the superstructures and substructures over Portage river, one located near the east quarter post, Section 21; the other near New Rochester, both in Freedom township, Wood county. The commissioners also invite and will receive and consider proposals on any other plans at the option of the bidders in accordance with Section No. 2345, General Code of Ohio. Bids will be received on separate parts of said improvements as follows: (1) On substructure complete on each bridge as per plans and specifications on file in county auditor's office; (2) On superstructures complete of each bridge as per plans and specifications on file in county auditor's office; certified check, $500, required with each bid for substructure, and $100, for superstructure, and made payable to H. J. Rudolph, county treasurer. Bids for the old wooden superstructure of bridge near New Rochester will be received at same time, but must be separate from bids received on substructure and superstructure of new bridge. Said bid must be conditioned upon prompt removal of old superstructure so as to not interfere with erection of substructure of new bridge. C. E. Stinebaugh, auditor.

Portsmouth, O.—Sept. 4, until 1 p. m., for furnishing labor and material for the construction and erection of the steel superstructure and wood sidewalk flooring for a bridge crossing the Scioto river at Portsmouth, consisting of four 336-foot spans and three 49-foot spans. Certified check, 5 per cent. of bid. Thos. C. Patterson, auditor Scioto county.

AUTOMOBILES—FIRE APPARATUS.

Grank Forks, N. D.—This city is in the market for a 65-foot aerial truck, two or three-horse hitch. Will consider a second-hand one if in good conditlon and price reasonable. Orr Sanders, chairman fire committee.

Kansas City, Mo.—J. C. Egner, chief of fire department, advises the purchase of three more chiefs' cars is being considered.

Philadelphia, Pa.—Abington Fire Co. No. 1, a volunteer organization, is to have a modern automobile type of fire-fighting apparatus, to cost approximately $4,000. Charles O. Kruger heads the committee, appointed to raise the funds, other members being Assemblyman Chas. A. Ambler, Harry S. Ambler, Jr., William Ferguson and Charles Bates.

Springfield, Ill.—Bids will be asked at once by H. B. Davidson, commissioner of public safety, for one motor combination chemical and hose wagon and one tractor to be attached to a steamer.

Washington Court House, O.—Ordinance was passed to use $10,000 in bonds for the early purchase of motor fire engine and other modern fire-fighting equipment. Mr. Flynn, city clerk; Mr. Smith, mayor.

BUILDINGS.

BIDS REQUESTED.

Oberlin, La.—Bids will be received until September 4, for the construction of a court house, which will cost about $75,000. The building is to be constructed of fire-proof material. The skeleton of the structure will be of reinforced steel and concrete and the exterior will be light gray pressed brick, with light gray oolitic limestone trimmings with gray terra cotta belt courses and cornices to match. The interior of the building is to be finished in cement plaster, hard, white finish with ornamental plaster cornices and wall paneling, the interior woodwork being oak. The building is to be modern in every respect, being equipped with electric lights and modern plumbing.

LIGHTING.

Houston, Tex.—The city of Houston is contemplating the installation of a municipal electric light plant. At first the plant will furnish electricity for municipal purposes only. Mr. Campbell, mayor.

Mackinac Island, Mich.—The Municipal Water, Light & Power Co. expects to purchase within the next six months a 250-k.w. direct connected generating unit for lighting load. A. J. Doherty, Jr., is secretary and treasurer.

Vol. XLV. No. 4. October, 1913. Twenty-five Cents.

MUNICIPAL ENGINEERING

The World's Leading Municipal Publication

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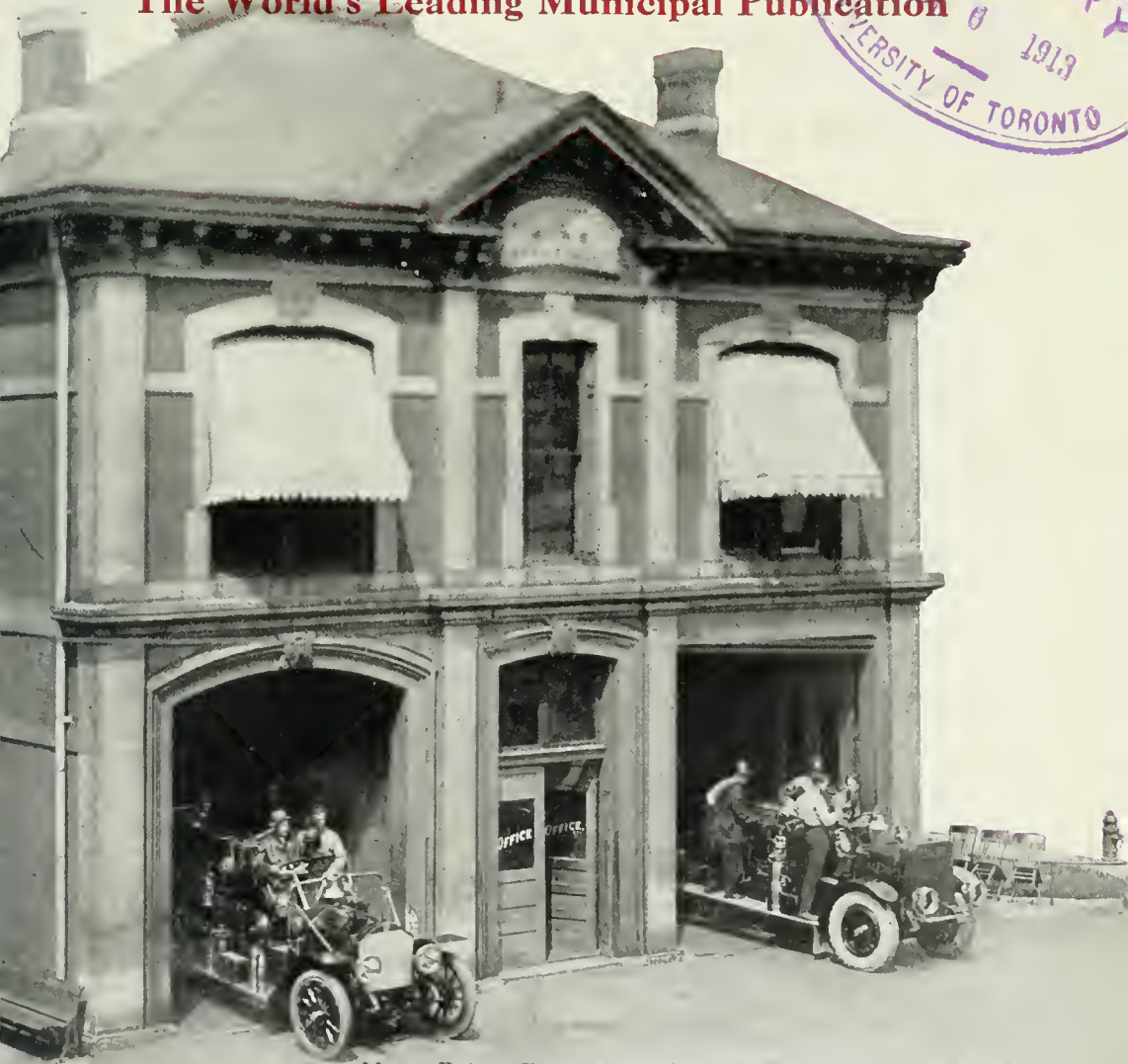

Motor Driven Equipment—Fire Headquarters, Indianapolis.

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The work of checking up the result of an election is similar and vastly more important than that done by the large corporations and businesses in checking up statements, balance sheets, etc. No modern business would think of conducting its record system as it did a few years ago. Every device is employed to safeguard accuracy and save time—the adding machine being, perhaps, the most important piece of equipment in the accounting department.

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MUNICIPAL ENGINEERING

The World's Leading Municipal Publication.

SEAGRAVE TRACTOR *in use in Cleveland, Ohio, drawing large ladder truck.*

VOL. XLV. OCTOBER, 1913. No. 4.

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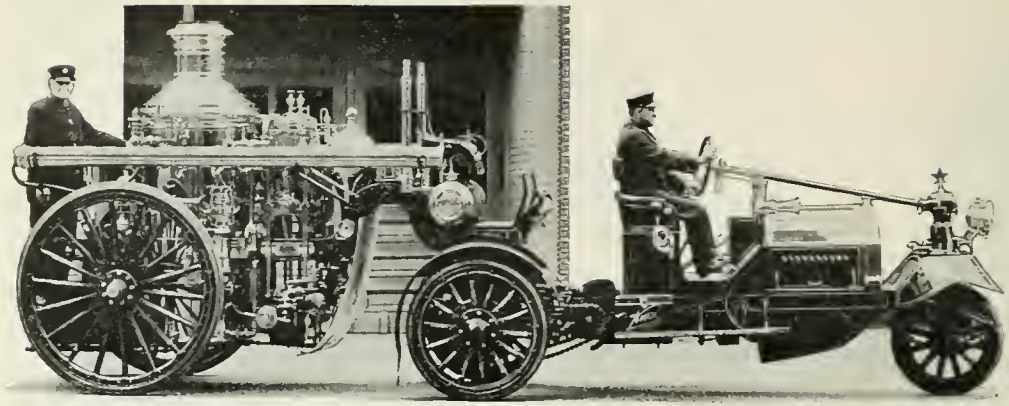


KNOX MARTIN TRACTOR *used in Springfield, Mass., to convert a horse-drawn steam engine into a motor-driven apparatus.*

CARE of MOTOR DRIVEN FIRE APPARATUS

by
J. M. TAYLOR,
Springfield (Mass.) Fire Department.

The following article has been given the first award in the contest inaugurated by this publication on the subject indicated by the above title. Mr. Taylor has given a very thorough description of the maintenance of motor apparatus, both electric and gasoline driven. The announcement of other prize winners will be found elsewhere in this number.

THE matter of care of motor fire apparatus in the Springfield Fire Department is rendered somewhat long and involved in explanation because of the fact that two totally different types of machines are used; namely, the electric storage battery and the gasoline. The former requires much more precision and attention to detail in its handling and care than does the latter, owing to the many details in which there must be perfect co-ordination. For that reason, as well as because the electric storage battery type of machine is not so familiar to many persons as is the gasoline, it will be well to treat with the electric type and its care first.

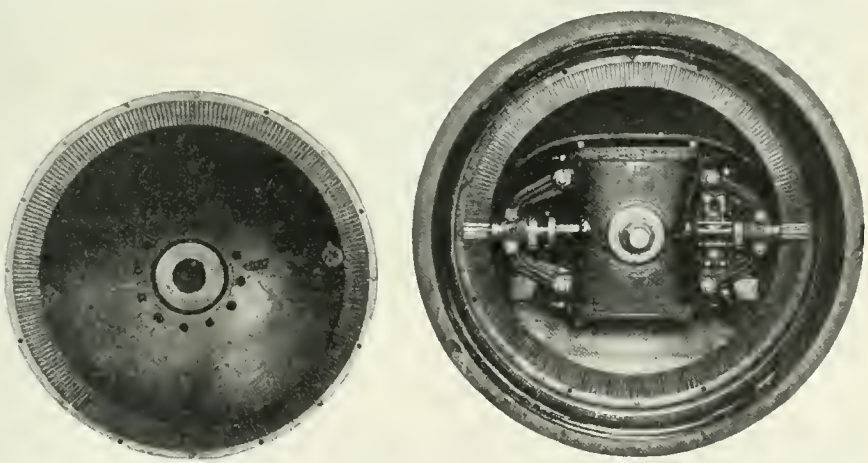
The five electric machines in use in this city are all equipped with the Couple-Gear wheels and are four-wheel drive. These wheels are peculiar in that their power is transmitted on the rims instead of on the hubs, the wheels being so constructed as to look like solid disks, altho in reality they are hollow metal boxes. Each wheel contains an armature, field coils, commutators and brushes, thus making the care of each wheel equal to that of an electric vehicle of the ordinary type, which in reality each wheel is. For every wheel is totally independent and is fitted with a fuse which will allow for the cutting out of one or more in case of an emergency, the vehicle then being pro-

pelled by the remaining wheels. This is made possible by the fact that the wheels are built to stand overload enough so that the cutting out of one or more will do no damage by overstraining the remaining wheels.

CARE *of the motor wheels is the important consideration in electrically-driven apparatus.*

Naturally the wheels form a very important part of the care of the apparatus and one of the most important items of their care is to be at all times certain that all connections are absolutely tight. Furthermore, they are practically air-tight and, because of lack of ventilation in them, moisture is bound to form to some extent inside. Then dust particles from the carbon brushes will mix with the moisture and adhere to the commutator, gumming it. The effects are two. First, when the armature becomes gummed the contact in the wheel becomes poorer with a resultant loss of power. Second, the accumulation of the gummed dust particles will cause excessive sparking, which will burn or score the commutator, which, in turn, adds still more to the sparking. If this is allowed to continue the commutators must eventually be removed and turned down to get a new surface. Therefore, it has been found necessary here to carefully clean the interior of the wheels after every third run when, if the commutator shows signs of scoring, it is smoothed with 00 grade sand paper. At this time, also, the connections are gone over and carefully tightened, for one loose connection will put a wheel out of service. Thus, the two essentials in the care of the wheels have been found to be absolutely tight connections and cleanliness, meaning a total absence of all foreign substances such as dust or dirt of any nature.

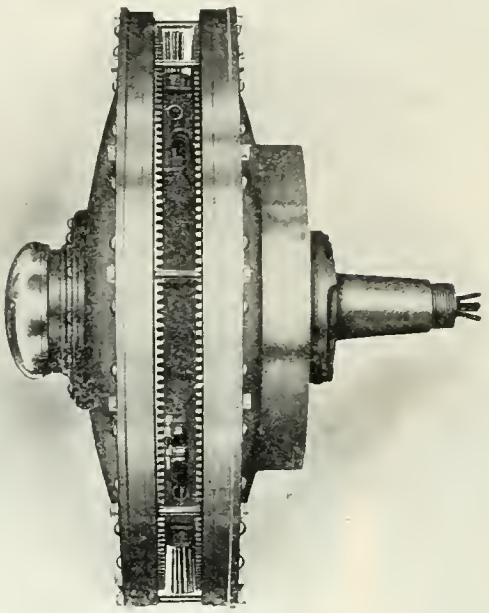
The National lead batteries are used in all the machines, being 80-cell, 17-plate batteries with a full charge power of 2½ volts per cell. They must be charged by a direct current, and as a 500-volt alternating current comes to the stations, it must be changed to a 250-volt direct current by means of a rectifier or reostat. In three stations a mercury rectifier is used, while the other two, which are equipped with electric apparatus, use reostats. In the matter of the batteries and their charging it must be borne in mind that the batteries are never entirely run out, a practice which tends to injure the battery. Therefore great care must be taken in their handling and charging.



VIEW *of Couple-Gear motor wheel showing front disk and side of motor removed, giving access to the armature, field coils and bearings.*

The batteries are recharged after seven average runs, at which time they are usually about half exhausted. At this time the plates are carefully looked after. These plates should never be allowed to become dry where their ends are near

the surface of the solution, but should always be covered by about half an inch of liquid. Therefore, if it is found that some of the plates have become exposed they are covered to a depth of half an inch with distilled water. Then, when the charging takes place, the water will mix with the solution, but it will begin soon after to rise gradually to the top. This is to be desired, for in this way it is the water and not the solution which is lost by evaporation or gasing. In case of sloppage, however, the jars are refilled with electrolyte instead of water, the electrolyte being 1,300 test.



TIRE *and band removed from Couple-Gear motor, showing relative position of the two pinions.*

In batteries, such as these, which are never totally exhausted, great care must be taken to prevent sulphation. If the batteries remain inactive for a period of several days sulphation will set in, and constant hydrometer tests are taken to prevent and guard against this occurrence. When the specific gravity of the solution begins to fall it is known that sulphation has set in and the machines are treated with what is known as an enlivening charge. That is, a very light charge is run into the batteries and is repeated at a later interval if the period of inactivity continues. There is great danger in this process, however, for unless care is used the batteries will be overcharged, and, to guard against overcharging, the solution during charging is frequently tested with the hydrometer. The only real cure for sulphation is use of the batteries, the enlivening charges being really little more than a staving off of the injurious process for a brief while in the hope of the machines being called into service. If sulphation advances, the batteries must be taken apart and treated. Because of the danger of sulphation electric storage battery fire apparatus is of very little value in any station where it will not receive an average of two or more runs a week.

As in the wheels, the connections of the batteries must be given considerable care, for one burnt-out connection will put half the battery out of service. The connections, furthermore, must be kept covered with vaseline in order to avoid the corroding action of the gases and acid of the solution. Likewise, as in the wheels, no dust or foreign substances must be allowed to get inside the battery covers.

When the battery reaches a point where its action shows it to be deteriorating fast, the life of it can be prolonged by having it taken out and overhauled, and by putting in new separators. The expense of this is small, and, as it prolongs the life of the battery from six to eight months, it pays to do it.

The same rule holds with the controllers as with everything else in the mechanism of these machines; their parts must be kept tight. If this is not done a flash at

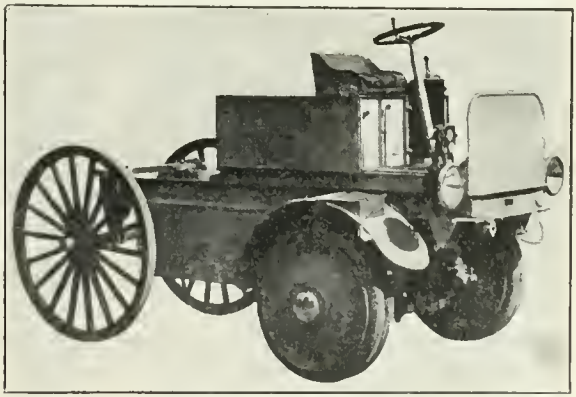
a loose finger will burn off the finger or will score the plate, requiring both a new finger and a new plate. On the other hand, too much tension will cause binding, which, if followed by too great pressure, will cause a buckling under that will burn out the entire controller. To guard against this, a very thin coating of vaseline should be kept on all parts of contact of the controller. Proper adjustment in the controller means a perfect contact, and in order to keep the adjustments perfect the controller is looked after every time the wheels are gone over, namely, once every three runs.

In the care of the gasoline apparatus in this department there is a wealth of detail which, though not as involved as that of the electric, is equally important in the maintenance of complete efficiency. There are, of course, rules governing the entire care of the apparatus, but in addition to the rules it has been found very beneficial to discover the men best suited for caring for the apparatus and to put the work in their hands so far as may be possible. Rules governing the care of apparatus may be found in every station where motor apparatus is used in any department, but it has been the experience of this department that much more is necessary in the care of motor apparatus than a strict observance of rules. Much depends on the men in charge.

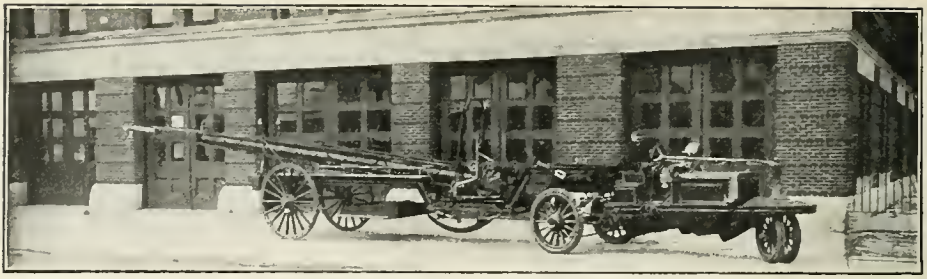
The rules for this department require that all motors shall be started at nine o'clock every morning and nine o'clock every night, at which time the engines and gasoline supply pipes are inspected. Furthermore, the captains must inspect all parts of the apparatus once each month and see that all nuts are tightened and properly locked; that chains are greased and grease cups filled; that the water in the radiators is changed and clean water run through pump and jackets; that all batteries and spark coils are tested; that spark-plugs are cleaned; that there is the required air pressure in pneumatic tires, plenty of oil in reservoirs and sufficient grease on wheel bearings; that the rear wheels are jacked up and grease worked into the transmission; that the wheels, steering gear and all other parts are properly adjusted; that the mud pan is removed and the under side of engine cleaned; that the frame, wheels and steering gear are touched up with paint and the mud pan, fenders, mufflers, and other exposed parts blackened, if needed.

Those are the rules, sufficient, it would surely seem, to cover every possible phase of the care of motor apparatus and to insure the condition of the machines. But the rules alone are not sufficient for this purpose. There are numerous things beside which have been found necessary, things which only long experience with motor apparatus could teach. For instance, there is an unwritten rule, but none the less binding for that fact, that the gasoline tanks shall never be allowed to get more than five gallons under capacity. Also, after about every five hundred miles of running, all the oil is drained off, the reservoirs and pipes are thoroughly cleaned and the oil replaced with fresh oil. This gets rid of the grit which is caused by friction in the mechanism.

One thing which this department has learned by dear experience is that great care should be taken in the quality of the gasoline which is used. All gasoline in use here now is carefully tested with a hydrometer when it is delivered at the stations and unless it tests 64 or better it



ELECTRIC TRACTOR *used in Springfield, Mass., for motorizing apparatus which has heretofore been horse-drawn. Tractor manufactured by the Couple-Gear Freight Wheel Co., Grand Rapids, Mich.*



HORSE-DRAWN *water tower converted to motor apparatus by connecting a Knox-Martin tractor.*

will not be accepted. It has been found that the quality of the average gasoline which is being sold is growing steadily poorer and that unless this matter is carefully watched the department will be loaded up with inferior gasoline to the detriment of its efficiency. High grade gasoline will start quicker and warm up quicker, which in cold weather will save many seconds, perhaps minutes. It costs but a fraction more, and its superior value more than pays the difference in the price.

EXPERIENCE *has proved that it is best to keep motors operating at slow speed during freezing weather when cars are at fires.*

In freezing weather the engines are always left running at low speed when at a fire, it being found that this is the only way to prevent them freezing. This department has tried alcohol in the water which cooled the engine, and the engine promptly froze up. It has also used air-cooled cars, which as promptly froze up, owing to the congealing of the oil in them.

In cold weather, or when the roads are slippery from rain, anti-skid devices are used on all wheels, whether equipped with pneumatic or solid tires. Also, on cars fitted with pneumatic tires which are frequently called into service, such as squad cars, chains are always kept on the wheels, being changed about once a month. This guards against possible accidents, and it is the aim of this department to guard against all possible accidents so far as is feasible. In furthering this policy it has been found advisable for the cars to carry a spare gasoline pipe which can be connected quickly to the carbureter, as the pipe in that location occasionally breaks because of the jarring of the machine.

It has been found advisable to center all responsibility for the condition of each machine in the driver, the drivers being changed at intervals so that each efficient man will not be allowed to get out of touch with the work. This centering of responsibility means that the driver must be ever on the alert to discover any little fault in the running of his car. He is not allowed to tinker with it when the car is running in a satisfactory manner, but whenever there is anything wrong he is required to find it and to repair it within the shortest possible time, provided the fault is one which he can remedy. In case of a serious fault or breakage he is required to report the matter at once to the officer in charge of the company, who will then take such steps as may be necessary for the repairing of the broken part.

It has been found here that the whole secret of efficient service from motor apparatus lies in the care which each machine receives while it is in the house. Every little suspicious squeak or knock is hunted up and the cause is remedied as soon as found. In fact, it has been found advisable to treat a machine much as a mother would treat a child, discover its symptoms, then discover the ailment and cure it within the shortest possible time.

The financial saving to be found in the use of motor apparatus is less a comparison than a contrast with horse apparatus. A maintenance sheet was kept in this department during the year ending March 1, 1913. The result was that motor apparatus was found to cost as follows: For the

year; electric, actual maintenance, $52; gasoline, average, $34. As a comparison by individual pieces, Truck 1, electric, cost $52 in maintenance; Truck 8, horse drawn, cost $620.42. Truck 1 made 148 runs during the year, and Truck 8 made 107. The cost of Hose 1, electric, averaged about the same as that of Truck 1, the hose company making 192 runs. Hose 10, horse drawn, cost $427.94 with 143 runs. Of the gasoline cars the lowest cost for the year was $15.61, for 63 runs, made by Hose 13; the highest was $37.40 for 110 runs, made by Hose 8.

A comparison of the two types of motor apparatus from a standard of care is difficult to make because of the diversity of their points, but there is no parallel whatever between them and horse-drawn apparatus in this line, every advantage lying with the motor apparatus.

There are two recommendations to be made to any city which is going into motor apparatus. This first is to assure the efficiency of the drivers and of the men who will have the care of the motor apparatus. If possible, it is most advisable for a city to engage an instructor and to place the training of the men and the supervision of the apparatus in his hands. This has been done in some of the larger cities with decidedly beenficial results, a practical school for chauffeurs of fire apparatus being established. As a substitute for a school this city has found it practical to place some of its men in a local automobile factory for periods of two weeks or more in order that they may gain practical knowledge of the assembling and manufacture of the machines.

Another suggestion lies in the change from the old practice of keeping lighted lanterns always on the apparatus at night, especially on gasoline apparatus. The burning of the oil lanterns is a constant menace in case gasoline should escape from the tanks or a broken tube, for the flame in the lantern will ignite the gas and cause a resultant explosion and fire.

There is one suggestion concerning a minor matter which has caused more or less trouble to many drivers of motor fire apparatus. It has been discovered here that when the electric siren grows weak, as it does at intervals, the cause does not always lie with the batteries. It will frequently be found at such times that if the motor of the horn is taken out and cleaned the fault will be remedied.

All gasoline machines in service in this department at the present time are Knox machines, including chiefs' cars, auxiliary squad cars, hose wagons and two Martin tractors. The electric ladders were built by the Seagrave Company, the chassis in each case being furnished by the Couple-Gear Freight-Wheel Company. The electric hose wagons are also equipped with a Couple-Gear Freight-Wheel chassis, but their bodies were built in this city according to specifications furnished by this department.

ONE *of the Springfield (Mass.) completely motorized engine companies. Machine on the left is a special squad and life-saving car, the one in the center a steam engine connected to a Knox-Martin tractor, and the one on the right a combination hose and chemical apparatus.*

No men have been actually displaced by the use of motor apparatus, altho each company equipped with a motor piece has in reality gained one man. This fact results from the difference in the mode of propulsion. No driver is required when a motor piece is standing at a fire, for there are no horses to be watched or cared for and no danger of runaways or of positions being changed by restless horses. Therefore, each company gains a man in the person of the driver of the motor piece, who, as soon as the apparatus is stopped, jumps from his seat and takes his place in the company, as a hoseman or ladderman according to the class of the piece which he drives.

The matter of actual saving to be made by motor apparatus over horse-drawn apparatus may be best summed up in the following figures: During the fiscal year of 1912 the department expended more than $9,000 less than was spent during the preceding year. This fact assumes added significance when it is noted that during 1912 the department was increased by 32 men and responded to 100 more alarms than during 1911. Furthermore, although the department is annually increasing the number of men in its manual force, its appropriation for each year is growing less as its horses and horse-drawn apparatus are being done away with.

There has been no desire in this department to decrease the number of stations. Our stations are situated where they are needed and any attempt to reduce their number would be extremely detrimental to the fire service. Also, as this city is growing with great rapidity, the call is for more rather than fewer stations. There is this point to be considered in the present condition of our stations, however. All our men now sleep in individual rooms which are as large as those to be found in ordinary hotels, and they have also splendid equipment for their general comfort such as lounging rooms, shower baths, etc. All our new stations are built with these accommodations, but these things also exist in the old stations. Where the horses have been done away with the portions of the buildings which were formerly used for feed lofts, forage bins and storage places for the innumerable bits of horse paraphernalia have been torn out and replaced with comfortable single rooms for the men. Large lavatories with shower baths and set bowls occupy places which were formerly given over to forage and rats, and a general toning up of the stations has resulted.

LARGE *savings are being effected in the building of fire stations for motor cars in place of horse apparatus.*

In the matter of stations lies a strong feature which illustrates the saving of motor over horse apparatus. A station built to house motor apparatus does not need to be nearly so large as one built for horse apparatus, even tho comfortable arrangements are made for the housing of the men. Here, in these days of the high cost of building materials, lies a tremendous saving.

Perhaps the best illustration of all of the superior efficiency of motor apparatus over horse-drawn is to be found in the experience of this city on the Fourth of July just passed when we suffered an epidemic of small fires. The total mileage covered by Headquarters at that time was 50 miles with the thermometer well above 90 all the time. All the fires were put out in short order and without any serious loss. But what would have been the result had horses been required to cover those fifty miles in a temperature of more than 90?

RESULTS OF GARBAGE REDUCTION

AT COLUMBUS, OHIO.

Hundreds of Cities Are Grappling With the Garbage Disposal Problem. Shall They Continue to Allow Contractors to Pocket Profits Which Rightfully Belong to the Municipality? Columbus Has Solved This Problem to Its Profit.

THE municipal garbage reduction plant at Columbus, O., has been in operation since July, 1910, and is uow in full working order. It was designed by Irwin S. Osborn, who was in charge of the construction of the plant and has operated it up to the present date. Mr. Osborn is now on a tour of observation of foreign garbage disposal plants and on his return will go to Toronto, Ont., to take charge of the municipal garbage plant, where he will doubtless repeat his Columbus success.

The plant was fully described in MUNICIPAL ENGINEERING, vol. xl, page 322, and the following brief description is given to show what changes have been made to improve the operation.

The reduction plant consists of five buildings: Unloading building, reduction building, percolating building, office and stable.

The unloading building is 45 feet wide by 85 feet long with elevated railway tracks extending thru it. It is used for the unloading and sorting of all garbage delivered at the plant.

The reduction building, which is 80 feet wide by 167 feet long, contains the reduction machinery, including digesters, presses, grease separating tanks, refining and storage tanks, drying equipment, screens and evaporators. It also contains the boiler plant, machine shop and water supply pumps. The part containing the digesters, presses, dryers and storage rooms is three stories high and the other part one story high.

The percolating building is 40 feet wide and 46 feet long and contains percolators for extracting grease, refining and distilling tanks for recovery of gasoline. All buildings except office and stable are constructed fire-proof of steel, concrete and brick.

The garbage when delivered at the plant is weighed on railway scales and then run into the unloading building. The body of the car is then turned on trunnions by means of power hoists and the contents are discharged on the floor below. The free water is drained off thru gutters, covered with perforated plates which extend full length of the building. The water from gutter is drained into catch basins from which it can be discharged into the grease separating tanks, after which it is evaporated.

The garbage is placed in a scraper conveyor, which extends the length of unloading building, thence thru housed truss to top floor of reduction building, and discharges directly into tops of the digesters thru swivel spouts.

The digesters are eight in number, 7 feet in diameter and 14 feet long, constructed with dished head and cone bottom. The capacity of each digester is 10 to 12 tons. The digesters are arranged in nests of four and connected to common receiving hopper by large gate valve and nozzle on the bottom of each digester.

The digesters when filled are sealed and steam is admitted at the bottom for cooking. The time required varies with the quality of garbage during the different seasons of the year. Any odors or gases escaping from the digesters are passed thru condensers and the insoluble gases thru deodorizing furnaces. When cooked the garbage is discharged from digesters into receiving hopper which is directly connected with an Edgerton roller press. The material as it passes thru the presses discharges the solids at the front into a scraper conveyor and the grease and water flow from rear of presses thru conduit into catch basins in the grease separating room.

METHOD OF HANDLING GREASE.

The water and grease are pumped from catch basins into a battery of tanks where the grease is separated by gravity. The grease is drawn off into treating tanks, from which it is pumped to a triple-effect evaporator and concentrated to a syrup so as to recover the solids in solution. The syrup or concentrated water is pumped to a storage tank on second floor of the drying room.

The conveyor from the roller presses discharges the solids onto the second floor over the dryers, and then feeds into one or two continuous dryers of the direct heat type. The dry material is elevated and discharged into conveyor which conveys the material to the percolating building.

The material in the percolating building is stored in large hopper with feeding spout fitted with undercut gates. The percolator is of the revolving type and charged from storage hopper above. The percolator holds approximately 10 tons per charge. When filled the percolator is sealed and flooded with gasoline. The gasoline acting as a solvent united with the grease and the combined gasoline and grease is drawn off at the bottom and discharged into distilling tanks. After the grease combined with the gasoline is extracted the material is still wet with gasoline. In order to recover the gasoline and dry the material, live steam is passed thru the material and the gasoline passes off as vapor thru vapor line connected with condenser, where it is condensed and returned to storage for future use.

The combined grease and gasoline drawn from the percolator is heated so as to vaporize the gasoliue, which in turn is carried thru vapor line to condenser and recovered. The condensed gasoline and steam from the condenser flows thru pipe to storage tanks where the water is automatically separated and gasoline is again ready for use. The grease after distilling off the gasoline is pumped into storage tanks ready for shipment.

The tankage or dry material after treatment is discharged from the percolator and conveyed back to second floor of drying building, where it is screened to remove rubbish or foreign material.

The tankage from screen is then mixed with the conceutrated tank water recovered in the evaporator and then passed thru the dryer so that all the solids origiually contained in the garbage are combined in a dry state. After final drying the material is elevated to storage or loaded into cars for shipment.

CHANGES WHICH DOUBLED THE DRYING CAPACITY.

During 1912 the drying equipment was changed from steam dryers to direct heat dryers for drying all material. This work consisted in the removal of two vacuum mixing dryers, the installation of one new direct-heat dryer with necessary furnaces and chambers and the rebuilding of the revolving steam dryer. The drying equipment was changed by the contractor who made the original installation, to complete the contract, and the city was put to the additional expense of constructing foundations and the labor required in rebuilding the revolving steam dryer. The changes made resulted in doubling the capacity of drying equipment and permit the drying of all material during the day shift of eight hours. It also permits the drying of material at less cost for labor, fuel and supplies. In connection with changes in dryers, tests were made in treatment of off gases and methods were developed for deodorizing them. Deodorizing condensers are now being in-

stalled and provision made for deodorizing all gases in high temperature furnaces.

PERCOLATING PLANT INCREASED GREASE YIELD 40 PER CENT.

The addition of the percolating plant, which was placed in operation during the month of January, 1912, proved a very good investment, very satisfactory results being obtained. Previous to the operation of the percolator the only recovery of grease was made by pressing, so that the material when dry contained approximately 10 per cent. of grease which was not recovered. During the year all solids were percolated and the yield of grease from the plant increased approximately 40 per cent.

The percolating plant was constructed at an approximate cost of $20,000 and during the year 203½ tons of grease was recovered by percolation, valued at $16,890.50. The cost of operating the percolating plant, including fuel, labor, gasoline and supplies, amounted to $4,601.97, making an earning from percolation amounting to $12,288.53, which is about 60 per cent. of the original investment.

During 1912, the amount of garbage reduced was 18,789.47 tons, as compared with 17,534.49 tons in 1911. The average tonnage per day was 60.03 in 1912 and 56.56 in 1911, counting 313 days as the year. In September, 1912, the tonnage reduced was 2,425.47, an average of 93.29 tons per day of operation. In February the average was only 43.45 tons per day.

By months, the average daily tonnage of garbage reduced was as follows:

January	45 tons
February	43 tons
March	45 tons
April	47 tons
May.	51 tons
June	54 tons
July	67 tons
August	85 tons
September	93 tons
October	64 tons
November	62 tons
December	55 tons
Average for the year	60 tons

This table is computed on the assumption that the plant received no garbage on Sunday.

The cost of operation was $38,503.69 for the year, or $2.05 per ton of garbage reduced, as compared with a cost of $1.85 a ton in 1911. Receipts from the products of the plant were $61,728.62, or $3.29 per ton of garbage reduced, as compared with $3.35 in 1911.

Repairs and renewals are charged to operation and a sinking fund charge of 3.36 per cent. on the total cost of $210,000 would extinguish the 4 per cent. bonds when they become due. These capital charges of 7.36 per cent. amount to $15,456 a year. The table of receipts and expenditures with this addition would read as follows:

Expenditures.

	Total	Per cent. of total cost
Supervision and labor	$24,170.86	45.2
Coal	7,442.73	13.4
Electric power	1,305.95	2.4
Repairs and renewals	1,717.73	3.2
Supplies	3,163.09	5.8
Office expenses	181.01	0.3
Chemical analysis	223.00	0.4
Miscellaneous	299.32	0.6
Interest and sinking fund	15,456.00	28.7
Totals	$53,959.69	100.

Receipts from Products.

Grease	$42,559.52	68.9
Tankage	17,537.04	28.4
Hides	1,544.49	2.5
Miscellaneous	87.57	.2
Totals	$61,728.62	100.

The receipts per ton of garbage reduced averaged $3.29. The total expense, including capital charges, was $2.87, leaving a net profit of 42 cents a ton, or $7,768.93 for the year.

Notwithstanding the increase in quantity of grease recovered by the new percolator, the receipts from products were only slightly greater than for the year 1911, the reduction in price at which the products could be sold reducing the total receipts even more than the increase in receipts due to increase in quantity of grease.

MUNICIPAL ASPHALT PLANT

of St. Louis, Mo.

Description and Costs of Operation of a Plant Which Has Made an Efficient Start.

IN the year 1911 the city of St. Louis contracted with Warren Brothers Company, of Boston, Mass., for a plant to prepare material for laying and repairing asphalt pavements which was in successful operation for part of 1911, all of 1912 and is now in daily use.

The plant is under the management of the street department, of which Charles M. Talbert is commissioner, and is under the direct charge of W. L. Hempelmann, the engineer of bituminous roadways of the street department, and O. S. Brighton, the general superintendent of asphalt repairs.

The plant was provided and put in operation by James C. Travilla when he was street commissioner, and the system adopted is largely due to him, although details have been worked out by his subordinates as named. Mr. Talbert was appointed to fill the vacancy caused by the resignation of Mr. Travilla and took his office very nearly at the close of the fiscal year of the city in April, 1912, so that the data given in this article are those of the preceding administration.

The total cost of the asphalt plant, exclusive of the concrete foundations, paid out of a special appropriation of $20,000 in 1911, was $19,875.64. It is located at Kings Highway and Eager Road on ground owned by the water department, and is served by a railroad switch, which accounts probably for its location rather decidedly away from the center of the bituminous streets of the city, although it is not far from the geographical center of the present city area.

A rear view of the plant is given in the photograph, showing the elevators for carrying the materials to the dryers, and the furnace for heating the sand drums. In the house above are the weighing and mixing machinery of the standard Warren plant. The small brick building at the right is the chemical laboratory. The office, storeroom and machine shop are in a building on the left, not shown. A rail of a delivery track shows in the foreground and also a corner of one of the bins for materials.

The layout is such as to make the handling of materials more than usually simple and inexpensive, altho some reductions in daily cost could still be made by expenditures for machinery for unloading and handling materials.

The methods of keeping accounts of materials used, labor, tools, etc., are very complete and make it possible to classify expenditures in almost any manner desired. As examples of the methods used two or three of the report cards are reproduced.

The first given is the team card, which gives full information of the amounts of material sent out, the time required to make the delivery, the location of the work to which delivery is made. Everything on these team cards, which are made out in duplicate at the plant, must be accounted for on the reports of the foremen in charge of the work to which deliveries are made.

The second and third cuts show the two sides of the daily asphalt plant report. On one side is the detailed account of the labor and teams used, including the overhead charge, and on the other side is the detailed account of the materials used in making mixtures sent out, with time losses and unit and total costs. These are made up from the foreman's and superin-

tendent's reports and prices paid for materials by a clerk whose duty it is to keep exact account of everything which comes into and goes out of the plant, whether materials, tools or labor.

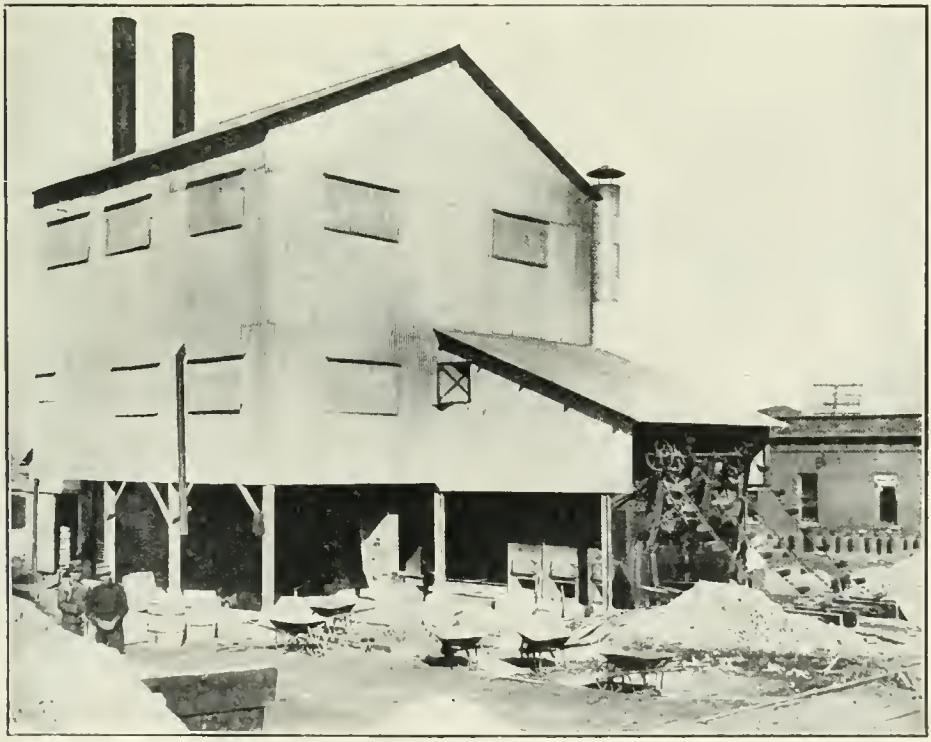
Each foreman in charge of a job makes out a corresponding daily card for the work under his charge. One side, which is practically the same as that on the plant card, gives the detail of labor employed and the other, shown in the fourth cut, shows the materials received and used. The two sets of column show the materials used in maintenance work and in private work respectively. The latter set is used for flush-coat work also. Prices are inserted and computed in the office.

The A. C. mixture used is designated by number and the cost is computed per ton, from the known cost of each ingredient. The total charge in kettle No. 1 is 14,055 pounds.

Top mixture A contains 115 pounds of A. C., 120 pounds of limestone dust and 800 pounds of sand, 200 pounds coarse and 600 pounds fine, per box. Top mixture B contains 115 pounds of A. C., 150 pounds of limestone dust and 800 pounds of sand of the same proportions of coarse and fine.

Each item in stock has a stock card with spaces for entering receipts and withdrawals and keeping exact tally of balance on hand so that an inventory can be made up at any time and it can be checked by measurements or counts of material in the stockroom, bins or tanks.

The overhead charges are computed at about $21.00 a day and include five men, the engineer in charge and clerk, the superintendent, chemist and helper. This charge is divided each day equally between the gangs at work, the asphalt plant counting as one gang, and any road-oiling gang being counted also. The division oils macadam streets and has



MUNICIPAL ASPHALT *plant of St. Louis, Mo., built by Warren Bros. Co. and operated by the St. Louis Street Department. This plant delivered and laid over* 105,000 *cubic feet of mixture at an average cost of* 61.2 *cents per square yard, during the year ending April,* 1913.

been doing some successful work in oiling and sanding and in flush-coating wooden block, brick, asphalt and bitulithic streets.

The figures from these reports are worked out in detail and summaries are made. From the summary by months the following figures are taken for the year ending April, 1913:

The plant delivered 105,287 cubic feet of asphalt mixtures during the year.

Labor cost for actual working time	$14,212.50
Idle time paid for	3,899.15
Material	17,588.27
Fuel	1,547.83
Labor of repairs	780.21
Total cost at the plant	$38,026.96

Municipal Asphalt Repair Plant
SAINT LOUIS

Kingshighway and Eager Road

_____ 191__

Location _____

Team: _____

Top / Binder ____ Cu. Ft.	Coal Oil ____ Gals.
____ Sand ____ Cu. Ft.	Napbtha ____ Gals
____ A. C. ____ Lbs.	Coal ____ Lbs.
Cement ____ Lbs	Wood ____ Cords
	Coke ____ Bu.

Flush Coat ____ Gals. Temp. ____ of

Mix: _____

Road Oil ____ Gals. Temp. ____ of Kind ____

Tools _____

2909

LEAVING ARRIVING

Time: _____

FOREMAN

Remarks _____

MANUFACTURED BY AMERICAN SALES BOOK CO. LIMITED, NIAGARA FALLS, N. Y.

A RECORD *of every load of material which leaves the plant is kept on this card. A separate card is used for each load.*

ST. LOUIS STREET DEPARTMENT
BITUMINOUS ROADWAYS
DAILY ASPHALT PLANT REPORT

Weather _____ Day _____ 19__

Cu. Ft. Mix. Top _____ Binder _____ Total Cost per Cu. Ft. Del'v'd _____

Material	Used	Price per	Mix. etc.	Total Cost	
Asphaltic Cement	Lbs.	Ton			
Asphaltic Cement	"	"			
F. Sand	Cu. ft.	Cu. yd.			
C. Sand	"	"			
Dust	Lbs.	Ton			
Cement	"	100 Lbs.			
Flux Oil	Gals.	Gals.			
Cup Grease	Lbs.	Lbs.			
Graphite	"	"			
Cyl. Oil	Gals.	Gals.			
Eng. Oil	"	"			
Coal Oil	"	"			
Naphtha	"	"			
Road Oil h'vy	"	"			
Road Oil lt.	"	"			
A. C. Paint	"	"			

Idle Time _____

Cause _____

Plant Repairs On _____

Material & Fuel Cost _____

Labor Cost _____

Foreman _____

THE DAILY *plant report, which gives the amount of each kind of material used and the cost.*

The total plant cost per cubic foot was therefore 36.12 cents. Not counting idle time paid for and labor of repairs, the plant cost was 31.67 cents per cubic foot. The latter varied between 27.29 cents minimum (January) and 36.64 maximum (February).

The amount of material reported as received on the street was 100,255 cubic feet, a loss of 5,032 cubic feet or 5 per cent., largely due to material turned out during the season for use during the winter by heating in pans. This amount laid 89,608 square yards of maintenance work and 4,059 square yards of private work, such as cuts in pavements, or a total of 93,767 square yards, making the average thickness of asphalt laid about 1.4 inches.

On the street the cost was for actual production labor	$16,673.06
For lost time	1,970.81
Total labor cost on street	$18,643.87

The plant cost of the material from above is.....$38,026.96
Fuel on the street cost..... 708.16

The total cost laid on the street is $57,378.99

The total cost of material actually delivered and laid on the street is 57.2 cents per cubic foot and 61.2 cents per square yard. The monthly average cost per square yard laid in the street, not including idle time and repairs, varied from a minimum of 28 cents in November to a maximum of 85 cents in March.

The private work in filling cuts in streets is done on notification from the department having charge of such excavations, the notice giving the name of the plumber, gas company or other party making the cut, as derived from the permit, the exact location of the cut, the area of cut and the amount of pavement adjoining the cut to be repaired. A duplicate of the permit is made on a sheet giving room for report of inspector which carries the plumber's and the inspector's signatures and dates of inspection, size of opening, etc.

Amount charged for repair of cuts is $2.00 a square yard for top alone and $3.00 for both concrete and top. Minimum charge on gas company's cuts is $5.00 and on some other contracts is $10.00. An amount is deposited equal to the estimated cost of the repair. The department making repair, in this case the bituminous roadways division, reports to the excavation division the cost of the repairs as computed on the blanks shown, so that the accounts are kept up to date.

The plant chemist makes determinations from each batch of penetration and bitumen, and at sufficient intervals to keep control, of percentages of bitumen and of mineral matter retained on No. 10, 40, 80, 200 and passing No. 200 sieves. The municipal testing laboratory tests and analyzes all materials offered for purchase and the plant chemist checks the quality of those delivered and controls the mixtures.

The city of St. Louis is establishing a uniform system of accounts on the basis of a preliminary survey of certain city departments, published in 1910, under authority of an ordinance passed in April, 1911. Peter White was employed in September, 1911, to make the revision. A careful analysis of all vouchers of the fiscal year ending April, 1912, was made, and all departments have been working toward a uniform system. It has been impossible, however, to work out all the details of this system in one year. An

LABOR REPORT, *upon which is recorded daily expenses incident to plant operation. On the reverse of this card appears the "Plant Report" shown on opposite page.*

Occupation	NAME	hrs.	Total		Occupation	NAME	hrs.	Total	
Overhead					Laborers				
Foreman					"				
Engineer					"				
"					"				
Clerk					Teams				
Timekeeper									
Stockman									
Blacksmith									
Chauffeur									
Fireman									
Mixerman									
Kettleman									
Laborers									
"									
"									
"									
"									

indication of the work done and to be done and of the forms of accounts and reports which have been definitely detailed is given in a special report of the bureau of revision and accounts and methods dated April 13, 1913. Meantime there are some duplications and overlapping of authorities which make difficulties, and some useless expenditures.

system of accounting is made wholly satisfactory.

This may be possible, tho it will be very difficult, and it can only be done by co-operation of the various officials with the bureau of revision of accounts, and particularly thru the recognition by that department of the importance of some rather minute details and of the

W 19__	MAINTENANCE			PRIVATE WORK-FLUSH COAT		
City of St. Louis Street Dept. Bituminous Roadways Asphalt Surface Laid	Street_____ From_____ To_____ Yds._____ Cost per yd._____			Street_____ From_____ To_____ Yds._____ Cost per yd._____		
NAME OF MATERIALS	Am't Used	Price per	Total Cost	Am't Used	Price per	Total Cost
Top Mixture	Cu. ft.	Cu. ft.				
Binder Mixture	"	"				
Asphaltic Cement	Lbs.	100 Lbs.				
Paint Mix.	"	"				
Wood	C'ds.	C'ds.				
Coal	Lbs.	100 Lbs.				
Cement	"	Lbs.				
Coal Oil	Gals.	Gals.				
Naphtha	"	"				
Sand { Meramec / Coarse River	Cu. ft.	Cu. yd.				
Flux ( )	Gal.	Gals.				
Labor Cost						
Material & Fuel Cost						

STREET FOREMAN'S *report on maintenance, flush-coat and private work. The labor report on the reverse of this card is similar to that on page* 327.

With respect to the bituminous roadways department, there are relations with the street construction department, the street maintenance department, and the excavation division, which must be worked out and put into their proper subordination or independence before the necessity of expert knowledge of them.

No system of co-ordination and co-operation of departments and divisions of departments has yet been devised in either private or public corporation management which will work without the co-operation of the individuals in those departments for the good of the service and not for the advancement of their individual interests.

A good beginning has been made in St. Louis and the work should be continued until all the details have been worked out, tho that may take several years.

LOCATING LEAKS IN WATER MAINS

***

Two successful but totally different methods.

IN two papers before the New England Water Works Association are given methods of determining the location of leaks in water mains which should be material aids in this difficult process. The first paper is by F. J. Hoxie, of Boston, Mass., on "Method of Locating Leaks iu Water Mains," and the second method of locating large leaks is taken from a paper by William W. Brush, deputy chief engineer of the Bureau of Water Supply, Department of Water Supply, Gas and Electricity of New York City, on "Water Waste Prevention Work in New York City."

Mr. Hoxie's contribution is abstracted as follows:

The possibilities of aquaphones and other acoustic devices having been exhausted in an attempt to locate leaks in the underground pipes of a factory fire service system, a method using an alkaline solution injected into the pipe was developed and located the leak within six feet. Similar success is reported in other cases.

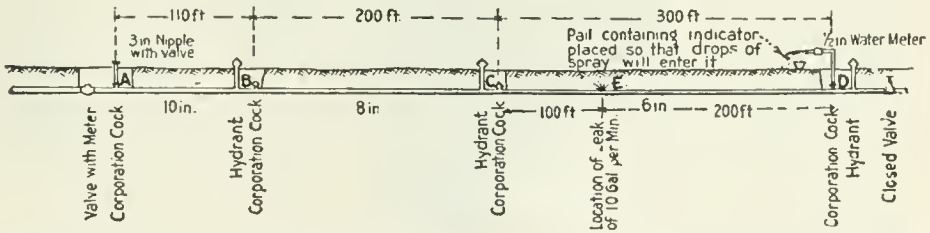
Caustic soda was selected because it gives a very sharp indication, is not particularly poisonous, and in the dilute solutions required has no objectionable color, taste, or smell and does no damage to pipes, gates, or fittings. Carbonate of soda, that is, washing soda, or soda ash, will work equally well. The method can be used on public systems by taking the precaution to shut off domestic connection while the measurements are being made, and flushing the pipes afterward.

After locating the leak within reasonable limits by use of section valves and meters, its magnitude should he determined by placing a small meter around a closed valve.

The case assumed by Mr. Hoxie is shown in the sketch and by closing the valve near D, and all connections from A to D and putting a meter on the valve near A, a leakage of 10 gallons a minute was observed.

Alkali is introduced into the piping as near as possible to the source of supply—at the point A in the sketch.

A ½-in. or ¾-in. hole is tapped in the pipe by use of a pipe tapping machine such as commonly used by the public water works. To the corporation cock at A, which is left in the pipe after it is



METER *on valve at extreme left. Closed valve on extreme right. Alkali admitted at A, B, C and D are points of making tests. Contents of ten-inch pipe A-B are* 110x4.08, *or* 449 *gallons. Contents of eight-inch pipe B-C are* 200x2.62, *or* 524 *gallons. Contents of six-inch pipe C-D are* 300x1.47, *or* 441 *gallons. Observed amount of leakage being ten gallons, time of flow thru lengths named is one-tenth their respective contents. Distance from D to E, location of leak, is observed discharge thru meter opened at D divided by* 1.47, *or* 200 *feet.*

tapped, a 3-in. nipple about 18 in. long is attached with a reducing coupling and nipple at the lower end and a 3-in. valve at the upper end to prevent the water from flowing out. When in place the corporation cock is opened a small amount and the 3-in. nipple allowed to fill with water. Then two or three pounds of solid caustic soda or potash is placed in this 3-in. nipple, the valve is closed, and the corporation cock is opened so that the caustic solution can diffuse into the pipe. The time that the corporation cock is opened is noted.

If the leak is beyond B the alkali will be carried to B as rapidly as the 10-gallon leak can change the water in the pipe A—B, or 449 gallons divided by 10 gallons, making 44.9 minutes. A few spoonsful of water drawn from the cock at B into a pail containing a half teaspoonful of phenolphthalein indicator will then show the arrival of the alkali. If it requires more time than 45 minutes, part of the leak is between A and B and part beyond.

Similar tests should be made at C 52.4 minutes after the first arrival of the alkali at B, to ascertain whether the pipe B—C is tight; likewise at D.

When the alkali fails to appear in 10 or 15 minutes after it is due, a meter should be attached and read and the water drawn off until the alkali test responds, when the flow is stopped. In the assumed case, observed flow being 294 gallons, the distance thru which the alkali was drawn by the water drawn off is 294 divided by 1.47, the capacity of the pipe per foot, or 200 feet, and the leak is 200 feet back from D.

If the pipe is level or slopes down toward D the point will be indicated nearer D than the actual distance as the caustic solution is heavier than water and tends to flow downward under the water. The same unreliability obtains of the slope is downward from the point of entry of the alkali to the leak, but if the slope is upward the accuracy will be within the limits of the conditions of the experiment.

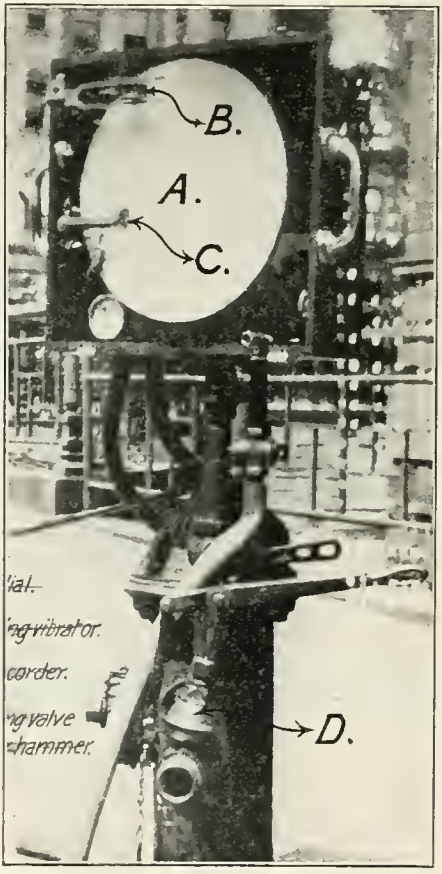
In case several leaks are indicated, the second test will locate the next leak along the line from D toward A, and so on until all are found and stopped.

The alkali should all be flushed out of the pipe thru the hydrants before the valve near D and the house connections are opened and the use of the water resumed.

This method will not be found of much service for single leaks of less than one or two gallons per minute.

Hydrants and calibrated nozzles can be used instead of corporation cocks and meter for preliminary or approximate determinations. The results are not as accurate, however, and leaky hydrant drips may give trouble.

The phenolphthalein solution is formed by dissolving the dry powder, which may be purchased at any chem-



LOCATING LEAK *in water main by Pulsograph, shown in place on hydrant. A—Recording dial. B—Time recording vibrator. C—Pressure recorder. D—Quick operating valve to create hammer.*

ical supply store, in the proportion of ⅛ ounce in a pint of wood alcohol.

Mr. Brush located leaks in distribution mains by the use of a "pulsograph," invented by Mr. A. Akimoff, of Philadelphia, which is shown in the accompanying photograph. This instrument is based upon the water hammer experiments made in Russia in 1897-98 and reported in paper by N. Jonkowsky before the Russian Technical Society, April 9, 1898. It consists essentially of a large sensitive pressure recorder having a rapid motion, a tuning fork vibrating at a rate of 200 per second, and a quick-operating valve which is on a blow-off or by-pass pipe.

The instrument is set up by screwing it to a hydrant nozzle, the hydrant being chosen so that there will be a straight run of several hundred feet before an open four-way branch is encountered. By closing valves on intermediate branches, the effect of a long isolated line can be obtained. In operation, the valve on the main below the hydrant is closed, and water allowed to flow from the hydrant thru the by-pass on the instrument. By quickly closing the by-pass valve, a water hammer of about fifteen ponnds is created and recorded on the pressure gage. This pressure is maintained until the water-hammer pressure has reached the open branch at the end of the pipe line that is being tested and the drop in pressure has traveled back to the hydrant, the tuning fork vibrations showing the time for this double travel. By dividing twice the distance along the main to the open branch by the time, the rate of travel for the particular pipe is determined. This has been found to be approximately 3,600 ft. per second for 6-in. pipe and increasing to about 4,200 ft. for 12-in. pipe. If there is any leak in the main, or in a service near the main, the water-hammer pressure is materially reduced by said leak and the chart shows separately the reduction due both to the leak and the open branch. The distance to the leak can then be determined by the time shown on the chart for the water-hammer pressure to travel to the leak and return to the pulsograph, this being multiplied by the determined rate of travel of the hammer pressure along the pipe, and divided by two. Several leaks have been located within limits of less than twenty feet by the use of this instrument, and the results from its further use should be interesting, as a decided saving in cost of locating leaks is anticipated.

PARTIALLY *blown joint leaking* 29,000 *gallons a day. Leak located by Pulsograph.*

MUNICIPAL SLAUGHTER HOUSE

at

Grand Forks, N. Dak.

Many of the Smaller Cities are Confronted with the Problem of Sanitary Slaughtering. This City will Operate Its Own Plant.

By H. G. Lykken, City Engineer.

GRAND FORKS, North Dakota, is a city of about 14,000 population, situated in an agricultural district, but where little attention has been given to the cattle industry. Only a small portion of the meat supply is available locally, yet the problem of a sanitary slaughtering house has been a serious one for a considerable time. One offensive and filthy shed where such work has been done was closed after the other. No private interest could be persuaded to enter the field and provide a sanitary place, however.

So the city took the matter up about a year ago, got a bill thru the legislature authorizing the cities in North Dakota to erect slaughter houses, and set about to gather information on the subject. The writer and the chairman of the ways and means committee of the city council visited Duluth, Minn.; Superior, Wis.; St. Cloud, Fergus Falls, and Moorhead, Minn., and Fargo, N. D. Information was gotten from the municipal plant at Paris, Texas, and other places.

It may not be so much of interest to know what the committee saw at these places. It would take too much space to record details, many of which would have little bearing on the object in view. Much was learned at each place and my endeavor shall be to summarize the conclusions arrived at. The city adopted the recommendation of the committee and has called an election for the issuance of bonds in the sum of $12,000 to erect the plant suggested and the writer is preparing plans for the same.

This plant will be constructed of brick, with concrete floors and tar and gravel roof. It will have a hog-killing room 15 by 30 feet, a beef-killing room 35 by 30 feet provided with three beds and hoists. There will be a cooler having an alley or entrance room 9 by 20 feet, and a cooling room proper 20 by 30 feet. This cooler is provided with a nice loft and sufficient ice is to be put in during the winter to run thru the summer season. Under the killing rooms is a basement 30 by 50 feet, cut up into various work and storage rooms. Adjacent to the killing room is a rendering room 10 by 15 feet. The top of the rendering tank is level with the killing floors so that all material can be conveniently dumped in. An outside door into the rendering room is provided for the admission of dead animals and material shipped in to be rendered. The tank proper is in the basement of the rendering room with an exit for the removal of tankage, and a door into the basement proper for the storage of the tallow.

This plant will be equipped with a system of trolleys thruout, a forty-horse power boiler, rendering tank and dryer, and, of course, all water and sewer facilities. Floors and walls up to a height of six feet will be finished with a hard portland cement plaster. The basement will

afford room for rendering lard and working up various other by-products, salting hides, etc.

The city will put a competent man in charge of the plant who will keep it clean, do the rendering and keep it in shape generally. He will also do such inspection of the carcasses as may be necessary to prevent the use of diseased animals. The intention is to let the butchers do their own work at the plant, as the local men claim they have to keep a certain amount of help anyway. A charge of 60 cents will be made for beeves, 30 cents for hogs and 25 cents for sheep and calves. This will include storage in the cooler for a few days.

It may be that the city will lease the plant for a term of years based upon its maintenance in accordance with the city ordinances, the proper inspection of slaughtered animals and a maximum schedule of charges.

In either case all meat not slaughtered under government inspection will have to be slaughtered in this plant. In case it is desired, the man in charge of the plant, or his help, if he needs some, will do the slaughtering for so much per head, additional.

¶ INSPECTION *of private plants influenced the layout and general design of this one.*

Referring back to the results of the inspection trip made and information gathered from other sources as the reason for the various recommendations made for the local plant, the following may be of interest. A hog-killing room was installed separate from the main beef-killing room for the reason that the use of hot water for scalding and the accompanying steam and odors are best kept out of the latter, and for the further reason that the work could be done at the same time in both departments with less disturbance of each other. Three killing beds were put in for the beef-killing as it was found advantageous to enable three sets of butchers to work at the same time.

The ice cooler was determined upon on account of the smaller initial cost as well as the smaller cost of operation. In a slaughter house such as the one planned, it is desirable to keep the meat for a day or more in some sort of storage. It would be of advantage to the butcher to have to kill only once or at most twice a week. Besides, it is generally recognized that the meat is benefited by a few days' refrigeration. As a temperature from 36 to 40 degrees Fahrenheit is sufficient for this purpose, a well constructed ice cooler will serve the purpose very well. If correctly designed, two hundred tons of ice will be put into the loft in winter, which will run the plant for the season, necessitating no attention whatsoever. There appears to be no call for a freezing temperature unless it is desired to go into a cold storage proposition. The freshly dressed animal is rolled into the alley or entrance to the cooler and left for twenty-four hours in order to rid it of the animal heat and considerable moisture given off at this stage of the cooling. This alley is well ventilated and the arrangement is absolutely necessary to obviate a damp cooler.

The rendering tank adopted is arranged for drying the tankage. After the tallow has been run off the remaining material is dried and sold as fertilizer. Both the tallow and fertilizer have good market value and will go a long way toward paying the operating expenses of the plant. There need be no perceptible odor about such a plant, as the materials to be tanked may best be put in while fresh. The tank is hermetically sealed and is not opened until the dry and powdery tankage is taken out. There is, of course, odor from the exhaust pump used when the tankage is dried, but this can be brought into the furnace under the boiler and destroyed. Every thing about the plant can be kept scrupulously clean, and all windows and doors should be screened. Condemned carcasses as well as other dead animals can be tanked out and provisions should be made to bring same into the tankage room from a separate unloading platform provided for that purpose.

Bond issue carried August 12, 1913.

Corrosion of Pipes by Raw and Treated Waters

By FRANK E. HALE, Mount Prospect Laboratory, Department of Water Supply, Gas and Electricity, Brooklyn, N. Y.

THE question of corrosion of iron pipes by water supply was given an extended investigation of six months at Mt. Pleasant laboratory during the first half of 1912. These experiments are the basis for the following discussion.

In order to understand the problem it is necessary to have a clear conception of the chemical reactions taking place. While the electric theory of solution tension of iron may be correct as the ultimate source of corrosion, it is my belief that the cart has been put before the horse and that the electrical phenomena result from the chemical action. Certain it is that the presence of carbonic acid is the most potent factor, coupled with the presence of dissolved oxygen. The action of these two agents is modified by the presence of other salts, increased by nitrates which furnish oxygen by reduction, decreased by carbonates which help to form protective coatings upon the pipe.

The chemical action takes place in the following order:

The first reaction is the solution of iron as bicarbonate by carbonic acid with the formation of hydrogen.

$$Fe+2H_2CO_3=FeH_2(CO_3)_2+H_2.$$

The dissolved oxygen in the water which is near the iron surface oxidizes some of the hydrogen back to water. After the oxygen near the iron is used up the hydrogen remains as a gas. In the cold reaction of our experiments the amount of hydrogen oxidized was found to be about 20 per cent.

The dissolved oxygen at the same time oxidizes the soluble iron bicarbonate to insoluble red iron setting free again the carbonic acid.

$$4FeH_2(CO_3)_2+O_2+4H_2O=2Fe_2+8H_2CO_3.$$
$$4FeH_4(CO_3)_4+O_2+4H_2O=2Fe_2+8H_2CO_3.$$
$$2Fe_2O_3+8H_2CO_3.$$

The carbonic acid, set free, again dissolves more iron and is again set free until all of the dissolved oxygen is exhausted.

The red iron oxide then acts as oxidizer until it is completely reduced to black magnetic iron oxide, setting free carbonic acid again.

$$FeH_2(CO_3)_2+Fe_2O_3+H_2O=Fe_3O_4+2H_2CO_3.$$

Reduction does not take place beyond this stage. These iron products are expressed in the equations as oxides altho differences of color, red, green, brown and black, coupled with varying stability on standing exposed to air indicate that they probably exist as hydrates, with the exception of the final black magnetic oxide obtained by hot action.

After all dissovled oxygen has been used up nitrates are completely reduced to ammonia, serving to supply oxygen.

$$HNO_3+H_2O=NH_3+O_2.$$

After all possible sources of oxygen are exhausted, the carbonic acid dissolves more iron, which is probably thrown out of solution finally as insoluble basic carbonate of iron, since after complete reaction there is only about 0.2 to 0.7 p.p.m. iron in solution, no free carbonic acid, no dissolved oxygen, no nitrate, sometimes no bicarbonic acid, and under some conditions caustic lime is present. The alkalinity of hard waters is reduced to about 25 p.p.m.

The carbonic acid for the solvent action may be derived from three sources, the free carbonic acid, the bicarbonic acid, and the neutral carbonate. In the

Paper read before the American Public Health Association.

latter case the carbonate hydrolyzes so that there are in solution neutral carbonate, lime hydrate, and carbonic acid. This takes place when the water reaches the stage that only neutral carbonate is present. The carbonic acid set free dissolves the iron. The presence of lime hydrate was proven by titration with phenolphtalein and methyl orange.

The rapidity of corrosive action is affected by the source of carbonic acid in order as given above, and the amount of soluble iron present during the active stages of corrosion varies with the above order of source of carbonic acid.

Another source of carbonic acid is that set free in alum-treated waters. This is really mostly bicarbonic acid set free. The amount set free per grain of alum per gallon is not as sometimes stated 6.8 p.p.m., but about 3.5 p.p.m. (determined by analysis). This is probably due to the formation of a basic carbonate of aluminum, $AlCO_3(OH)$, rather than the hydrate, $Al(OH)_3$. The compound formed probably varies somewhat with the temperature and may be mixtures of $AlCO_3(OH)$ and $Al_2(CO_3)(OH)_4$. Probably $Al(OH)_3$ forms only upon boiling, as in chemical analysis. The amount of free carbonic acid given, 3.5 p.p.m., agrees with the results obtained at the Little Falls filter plant.

It must be understood that the facts as given above apply to new pipe with a clean iron surface and to complete reaction.

Attempts to remove dissolved oxygen from water appear to me to be hopeless as well as expensive, because a consideration of the above reaction brings out a fact that seems to me to have escaped general attention, and that is that 15 per cent. of the oxygen in the iron oxides formed by complete reaction, if all the hydrogen were set free, comes from the water and not from the dissolved oxygen, and the greater part of the hydrogen is set free.

A very large amount of iron is corroded for each part per million of dissolved oxygen, thru the catalytic action of carbonic acid and water. For example, 10 p.p.m. of dissolved oxygen produces 126 p.p.m. Fe_3O_4, expressed as Fe, whereas if the hydrogen were oxidized and not set free, the amount which 10 p.p.m. oxygen could produce would be only 31 p.p.m. iron. In our experiments 75 to 80 per cent. of this theoretical amount of iron was produced, the difference from theory being due to oxidation of hydrogen. This is a variable quantity, but about 85 per cent. of the hydrogen oxidized was oxidized during the first fifteen minutes, which substantiates the idea expressed previously that oxidation of hydrogen takes place only at the surface of the iron while dissolved oxygen is present near the iron. The presence of hydrogen gas is easily shown and has been proven by many investigators. Any hydrogen set free means an equivalent amount of oxygen obtained from the water to oxidize the iron.

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¶ EXPERIMENTS *conducted with three kinds of pipe.*

The experiments were carried out with Byers wrought iron pipe (protected with an inside coat), Reading wrought iron, Black mild steel, and galvanized wrought iron. The first three showed no differences in the corrosive action when carried to completion, but the steel appeared to corrode most rapidly. The galvanized iron showed great resistance at first, but gradually, especially with alkaline water, the action increased somewhat, tho in the time of our experiments the highest amount was only about one-third that of the other pipes.

Experiments with regard to speed of reaction brought out some surprising facts.

About 50 per cent. of the iron produced by corrosion in the cold is produced in two to three hours. With Croton water (5 p.p.m. free carbonic acid) the action is practically complete in fifteen hours. This explains the greater tendency in house services, especially in new services, to show rusty water when first drawn in the morning, since the action is complete over night.

The rate of corrosion is increased proportionately to the increase in free carbonic acid. The action cold was complete

in seven to eight hours with Croton water containing 25 to 50 p.p.m. free carbonic acid. The total iron was also somewhat increased with the higher free carbonic acid. The carbonic acid hastens the action by dissolving the iron more rapidly. There being more iron in solution, oxidation is hastened. Analyses for soluble iron and dissolved oxygen proved this to be true. The carbonic acid increases the total iron by forming basic carbonate of iron which is left unoxidized after available oxygen is exhausted.

Alum-treated water showed no appreciably greater corrosive action either in speed or total amount of iron than untreated water. This is due to the comparatively slight increase in free carbonic acid (3.5 p.p.m. per grain of alum per gallon).

Neutralization of the free carbonic acid retards the corrosive action. Neutralization of the free carbonic acid by lime hydrate or by sodium carbonate retards the corrosive action. Neutralization of the free and half-bound carbonic acid by lime hydrate, provided there is no excess caustic, still further retards the corrosive action, and also reduces the total iron produced by cold action 33 per cent. and by hot action 50 per cent. Neutralization of carbonic acid retards corrosion by reducing the amount of dissolving agent, hence the amount of soluble iron present at any moment, and thus slows up the oxidation.

The slightest excess caustic (a few p.p.m.) up to considerable excess hastens corrosion to almost identically the same degree as does increasing the free carbonic acid to 25 to 50 p.p.m. A large excess of soda-ash acts likewise. This action of alkalies has been noted by Cushman and others.

Excess alkali hastens the corrosion by hastening the absorption of oxygen by the iron in solution, tho this is smaller in amount at any time. Until the excess of alkali is sufficient to prevent hydrolysis of carbonates the corrosion takes place. Analyses proved that the oxygen is absorbed faster and that only traces of iron are in solution at any time. Compare in this connection the Levy method of determining dissolved oxygen in water, i. e., oxidation of ferrous salts in alkaline condition.

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¶ RED WATER *trouble caused by an excess of iron dissolved or suspended.*

The excess of alkali necessary to stop corrosion completely is 100 to 125 p.p.m. excess lime hydrate over that needed to neutralize the free and half-bound carbonic acid. Only slightly more is needed to stop corrosion hot than cold. This amount of excess alkali acts by completely preventing solution of iron, for the oxygen still oxidizes the surface of the iron and is completely gone in twenty-four hours, altho no iron over the original amount appears in the water.

The above facts show that whatever helps to put iron into solution is the real cause of red water trouble. It is the iron in the water, dissolved or suspended, which causes trouble, not the iron clinging to the pipe.

All corrosive action was hastened by heat (120-150 degrees F.) so that complete reaction was accomplished in one and a half to three hours on the clean iron surface. Heat hastens corrosion in at least four ways—by hastening the chemical action of solution of iron, by increasing the amount of free carbonic acid since heat sets free the half-bound carbonic acid of the alkalinity, by creating convection currents that cause the dissolved iron to diffuse more rapidly and hence come in contact with the dissolved oxygen faster, and by hastening the oxidation and precipitation chemically of the dissolved iron.

The water of the Flatbush Water Company, which has a hardness of about 140 p.p.m., contains only two-thirds as much oxygen as Croton water and 10 p.p.m. free carbonic acid, produced corrosion as rapidly as Croton water on the clean iron surface aud a total amount proportional to the oxygen and carbonic acid content as required by theory. Yet in service this water causes no complaint and is generally free from iron and turbidity. This is undoubtedly due to protective

scale formed on the pipe, probably consisting of both iron oxide and carbonate of lime. As previously stated the alkalinity of hard waters is reduced to about 25 p.p.m. when the action goes to completion.

Dissolved oxygen disappears rapidly in all cases. In the first fifteen minutes 23 to 37 per cent. were used up due to oxidation of both hydrogen and dissolved iron.

The relative speed of oxidation is best seen in comparing percentages of oxygen used up to one and a half hours.

almost proportional to time and the iron precipitate is red (Fe_2O_3). After exhaustion of the oxygen the reaction becomes slower, the red oxide being reduced to the lower black oxide, turning green to brown to black. The color of the precipitate gives a good indication of the progress of the action.

While there is dissolved oxygen present there is iron in solution, depending upon the amount of active carbonic acid. Soon after the oxygen disappeared it was but rarely that more than 0.5 to 1.0 p.p.m. iron was in solution. The amount of

Temp.	Croton Water	Free CO_2	Bicarbonic acid	Lime hydrate excess	Oxygen used up
1	Hot untreated	5 p.p.m	10 p.p.m.	.....	100 per cent.
2	Cold, modified	0 p.p.m.	0 p.p.m.	27 p.p.m.	87 per cent.
3	Cold, modified	25 p.p.m.	10 p.p.m.	.....	87 per cent.
4	Cold, untreated	5 p.p m.	10 p.p.m.	.....	78 per cent.
5	Cold, modified	0 p.p.m.	10 p.p.m.	.....	75 per cent.
6	Cold, modified	0 p.p.m.	0 p.p.m.	.....	68 per cent.

It is noticeable that the increases of dissolved oxygen used up in No. 3, No. 4 and No. 5 are approximately proportional to the increases in free carbonic acid in the water.

So long as there is oxygen in solution the reaction takes place rapidly and al-

soluble iron present while dissolved oxygen was present is shown below.

It is obvious that the amount of dissolved iron is greater with increase in the active carbonic acid.

The amount of oxygen within wide limits does not seem to affect the rate of

Croton water	Free CO_2	Bicarbonic acid	Lime hydrate excess	Soluble iron
Modified	0 p.p.m.	0 p.p.m.	27 p.p.m.	0.35 p.p.m.
Modified	0 p.p.m.	0 p.p.m.	.....	0.76 p.p.m.
Modified	0 p.p.m.	10 p.p.m.	.....	3.50 p.p.m.
Untreated	5 p.p.m.	10 p.p.m.	.....	5.50 p.p.m.
Modified	25 p.p.m.	10 p.p.m.	.....	7.90 p.p.m.

corrosion materially, but the total amount of iron removed from the pipes in complete reaction, other factors remaining the same, is directly proportional to the dissolved oxygen in the water.

When iron pipe is exposed to the continuous action of water, as in service, a protective coating forms according to the nature of the water. Its action is to delay corrosion rather than to stop it and to reduce the amount of iron appearing in the water. The corrosion goes on slowly but the oxides cling to the iron, increasing the amount of scale. In cold action the greatest protection was acquired experimentally in ten days and then remained constant. Flatbush and Brooklyn waters caused a better protective coating than Croton water. The iron produced in twenty-four hours dropped from 114 and 84 p.p.m. respectively for the two former to 21 p.p.m., Fe., for the Croton and its modifications from 56-102 to 29-35 p.p.m., Fe. Croton was tried in four modifications, untreated, with free carbonic acid neutralized by sodium carbonic acid neutralized by lime hydrate to bicarbonate, and treated with one grain per gallon of alum.

In hot action the protective coating formed in two days. Flatbush water reached the lowest level of 3 p.p.m. iron with an average of 8. Brooklyn water reached 4 p.p.m. iron with an average of 9. Untreated Croton fluctuated high and low with an average of 41 p.p.m. iron. The alum-treated Croton averaged 26. The soda-neutralized Croton averaged 23 p.p.m., Fe. All the averages, cold and hot, include results from the tenth to the twenty-first day.

The pipes which had acquired a protective coating from these different waters were subjected for twenty-four hours to the action of untreated Croton water and to Croton water containing 20-27 p.p.m. free carbonic acid. The water with increased carbonic acid produced an average of 38 p.p.m. iron from the pipes with scale formed in cold action, against 24 p.p.m. produced by untreated Croton (5 p.p.m. CO_2). On the pipes with scale produced in hot action about the same relative quantities were produced, 34 against 22 p.p.m., Fe., showing that water containing the greater amount of carbonic acid causes more corrosion upon pipes protected by scale.

The scale produced by Flatbush, Brooklyn, and soda-neutralized Croton water proved the more protective.

GENERAL SUMMARY.

Extensive corrosion takes place rapidly in new pipe while the iron is fairly clean from incrustation. This explains the abundance of complaints of iron rust in new service installation.

Concerning the kind of pipe there is little doubt that steel pipe is most readily attacked, wrought iron next, and galvanized iron the least. The latter is far preferable for use. Lead pipe should never be used any more than absolutely necessary because of the danger of accumulative poisoning with minute amounts of lead (less than 0.5 p.p.m.).

The chief agent in dissolving the iron is carbonic acid, as it is also the chief agent in holding iron in solution.

The chief agent in carrying the rusting to the greatest extent is oxygen.

Thru the catalytic action of active carbonic acid, about 70 per cent. of the oxygen in the iron rust comes from the water by chemical decomposition, hydrogen gas being set free. The remainder only, about 30 per cent., is furnished by the dissolved oxygen in the water.

¶ SOFT *water containing much free carbonic acid causes the most trouble.*

Waters which give the most trouble are very soft and contain considerable free carbonic acid.

Hard waters rarely cause complaint as they form an excellent protective coating on the pipes.

The action in distribution services probably never reaches completion on account of protecting scale of oxide, etc., which retards corrosive action. The scale varies with different waters in protective prop-

erties. Tap samples in New York City have shown no appreciable diminution in dissolved oxygen or in free carbonic acid, so that only slight corrosion can have taken place in proportion to volume of water and possible reaction. Even hot services have shown the usual amount of carbonic acid and more oxygen than would saturate the water at the temperature when drawn.

Since in distribution services there is no exhaustion of oxygen, any increase in free carbonic acid may mean a possible increase of soluble iron in the water, which would be precipitated in the hot water supply.

Neutralization of free and half-bound carbonic acid is impracticable as it tends to hasten corrosion if there be the slightest excess of hydrate, removes zinc when hot from galvanized pipe, interferes with alum precipitation and color removal, and produces considerable precipitation of calcium carbonate in the water, which would deposit in the pipe system, meters, etc., unless previously removed by filtration or sedimentation.

Neutralization of only free carbonic acid is feasible, since it retards corrosion and reduces the amount of soluble iron.

Either soda-ash or lime oxide may be used. Both reduce the corrosive action, cold or hot. Only sufficient lime should be used to form bicarbonate. This reagent increases the hardness 1.1 p.p.m. for every 1 p.p.m. free carbonic acid neutralized to bicarbonate. About 5.3 pounds CaO per million gallons of water are required for each 1 p.p.m. carbonic acid. It is best handled dry. It costs about two cents per million gallons per 1 p.p.m. carbonic acid.

Soda-ash is more soluble, can be handled in concentrated solution and consequently in small sized tanks, and probably with better regulation of dosage, would not increase the hardness, but on the contrary would decrease the lime sulphate in the water, changing it to sodium sulphate, thus improving the water for boiler use and for other industrial purposes. It also apparently helps to form a better protective coating on the pipe. About 20.2 pounds soda-ash per million gallons of water are required for each 1 p.p.m. carbonic acid. This would cost about 20 cents per million gallons for each 1 p.p.m. carbonic acid. Soda-ash has been used successfully on a small scale to obviate red water trouble. The great difference in cost is due to greater molecular weight, less combining power, and greater cost per pound. The cost must be considered in connection with the degree and advantage of the change of sulphates to carbonates, etc.

Aeration of water by splashing followed by neutralization of residual free carbonic acid (about 5 p.p.m.) is probably the best practice.

ROOTS *removed from sewers. Growths of this character indicate clearly the necessity of cleaning old sewers. Troubles like this can be largely eliminated by careful construction of joints.*

Street Cleaning Department of Baltimore, Md.

By STUART STEVENS SCOTT, Baltimore, Md.

WITH a department as well equipped as any in the country, Baltimore is winning fame as being one of the cleanest of American cities, despite the handicap of having the reputation of having less smooth streets and more cobble stones.

The repntation of being a clean city has not been earned without hard work on the part of the commissioner of street cleaning, William A. Larkins, who, first as district superintendent and now as chief, has put in fourteen years. During eleven years of this period Chief Larkins carried out many of his own ideas in his particular district, winning the commendation of his chief and having the satisfaction of seeing his ideas put into operation in other districts. For the past three years, as the commissioner, he has had full sway and he has used his knowledge and authority wisely, building up a department that is in many respects a model one.

UNSANITARY *and uneconomical old-style garbage cart.*

Altho municipal departments are naturally influenced by politics, the street cleaning department of the Monumental City is affected as little as any similar department anywhere. Chief Larkins and his staff look upon their men from one angle—efficiency—and that is the end of the argument. It is useless to argue. Unless the man is efficient he does not remain, no matter how good his political backing. If he is good in his work he is not only commended by his superiors, but annually, the best men are picked out and the mayor of the city pins upon his breast a little bronze medal on which is the word "Efficiency." And the men strive for this honor. Day after day, thruout the year the men labor on, each aware of being watched and each aware that only steady application to his work will warrant his being called some pretty May day when they will line up before the mayor, receive their honors and become envied by their less fortunate or less ambitious fellow workmen.

The street claining department of Baltimore is extensive. Its annual appropriation is over $800,000, yet every penny is so carefully expended that each year since he has been in office Chief Larkins has returned a balance to the city. Last year (1912) he returned $61,000.

Chief Larkins' staff consists of a deputy commissioner, a chief clerk, a paymaster, two clerks and a stenographer in the office, four general superintendents, eight street superintendents, a superintendent of machines, an inspector and two assistants to look after garbage, two garbage dump inspectors, four foremen mounted on motor cycles, three foremen in the sanitary division and a chauffeur for the department automobile, used by the chief.

The corps of the department includes 310 sweepers, 150 street cart drivers, 30 sewer laborers, 12 drivers for sewer carts, 22 drivers for street sweeping machines, 205 garbage cart drivers, 10 drivers for squeegee machines, 2 scavengers for dead animals and 2 drivers for the garbage automobile. Directly in charge of this corps is a force of 24 foremen.

The stable equipment is extensive. There are four stables housing 310 horses, all property of the city. To take care of the animals there are at each stable a foreman and three hostlers. The department also has its own blacksmith shop, wheelwright shop, paint shop and sail-

TYPE *of garbage cart which has displaced those formerly used.*

BALTIMORE *White Wings, each man begins his day's work wearing a spotless uniform. No employe works over eight hours, but in some districts gangs are worked at night.*

loft, for each of the new sanitary wagons have canvas covers.

Including all hands there are on the payroll of the department 800 men and the annual payroll amounts to $525,000. Chief Larkins' salary is $3,000, and his deputy receives $2,000. Cart drivers and laborers receive $2 per day of eight hours; cart drivers who own and use their own horses receive $3 per day. Foremen receive $15 per week; superintendents of street cleaning $1,000 per year, and superintendents in the sanitary division, $1,200 per year.

SQUEEGEE *street cleaner, a number of which are in constant use.*

It costs, annually, about $66,500 to remove the garbage alone, but there is something in the way of remuneration to offset this, for the city has a contract, with a sliding scale, with the Southern Products Company, which not only takes all of the garbage, but which pays about $16,000 a year for it. This products company has a plant 10 miles from the city and all garbage is converted into grease which is used in the making of soap and axle grease.

The disposal of street sweepings and ashes is more serious, inasmuch as public dumping grounds are becoming scarce. Time was when there was a dump in each

section of the city. Now it is necessary to load the refuse on scows and carry it 10 or 15 miles down the bay. The long hauling of ashes made it necessary to adopt a more rapid means of transportation than horses, hence the purchase of a 7½-ton motor truck.

This truck has been in service about three months and it has proven so satisfactory that next year another truck will be bought. The truck goes to one section of the city one day and to another section another day and each trip it carries a load equal to what 26 street carts can carry. The time saved on each trip is equivalent to two and one-half hours per cart.

The scow service costs 23 cents per cubic yard of refuse and the records show that last year there were enough cubic yards disposed of to warrant a voucher for $25,000 being drawn in favor of the contractor.

Chief Larkins is more than ordinarily proud of his street men, his "white wings," for every day each man starts out in spotless white canvas overalls. There are all sorts of hours for the gangs. Some work all day, others all night, while there are gangs that start late and quit early, but no man works more than eight hours.

This assortment of hours, however, necessitates an almost eternal vigil on the part of the chief but, so far, he has proven equal to the situation and his big black automobile is just as likely to be seen purring around at 3:30 in the morning as at any other time. So too with the motorcycle corps. The quartet shift their working hours every week or two so that there is hardly a night but one of the four is riding around the city.

It is this vigilance on the part of the chief that has made the department what it is and have such an excellent record. Each year the chief calls all hands together and after the presentation of efficiency medals by the mayor the whole department parades thru the city. In this parade is not only practically every man in the department, but every piece of apparatus, each slicked down with bright paint, so that the people of Baltimore may see just where their tax money goes.

SEVEN *and one-half ton truck used by the Baltimore Street Cleaning Department.*

WATER SOFTENING AND DECOLORATION

at Grand Rapids, Mich.

By WALTER A. SPERRY,
Chief Chemist at Filter Plant, Grand Rapids, Mich.

THE first six months of experience at the Grand Rapids filtration plant has demonstrated that no plant can be successfully run by "rule of thumb." Every water supply, especially if it be a surface water supply, carries some features that make the treatment of that water distinctive and set apart.

The Grand Rapids plant started full normal operations about November 1, 1912, drawing water from the Grand river, it being originally proposed to soften this water down to about 125 parts per million total hardness, or what is generally known as the Lake Michigan standard, and to reduce its color to 10 or less on the platinum cobalt scale.

The Grand river drains an area of some two thousand square miles of sandy soil full of marshes and small lakes, with but little clay ground, being largely adapted to orchards and small fruits. Moreover the water is quite hard, due to limestone outcroppings. When one steeps tea leaves in water there results a color, an odor and a taste. The distinctive problem at the Grand Rapids plant has proved the removal of the effects of the steeping of the meadows in water that subsequently reached the Grand river. The problem was rendered more difficult in that in addition to its color the water was hard and hard waters seem more difficult to decolorize than soft waters, provided there is an absence of clay.

In this respect it is interesting to compare the water supply of Columbus, O., with that of Grand Rapids. The Grand Rapids supply, as noted above, is drawn from a sandy soil underlaid with limerock containing but little clay and with much vegetation and spotted all over with lakes and ponds. The Columbus supply is taken from the Scioto river, which flows thru a limestone region, wholly clay, and devoted to general farming operations with little or no swampy ground and but little sand. This result is a water at Columbus whose turbidity and total hardness rise and fall thru great ranges in very short periods of time, it being not unusual for the turbidity, for instance, to increase from 25 to 2,200 parts per million in a period of eight hours following heavy rains over the water shed, with a corresponding decrease in the hardness of the water. These phenomena are due to the clay nature of the soil, which lacks the "soaking up" and conserving capacity of lakes and sands and makes the Columbus problem largely one of coping with rapid changes of turbidity and hardness but with the color problem removed, in that the presence of much clay in this water tends to absorb and therefore eliminate its color.

¶ OBSTACLES *which it has been necessary to overcome.*

At Grand Rapids, on the other hand, the highest turbidity observed in the past six months has only beeu 135 with an average turbidity of 20 p.p.m. Moreover, due to the watershed being twice the area of the Scioto watershed, and due to the

much sand and many small lakes which tend to absorb and conserve storm water, the river does not rise and fall so rapidly nor does it get very turbid, and because of the absence of much suspended clay, turbidity, the color as well as a slight marshy taste and odor which accompany the color are much more persistent and difficult of removal. A secondary effect in rendering the color, odor and taste more difficult of removal is found in the opportunity for leaching out of the vegetable matter over the watershed offered by the conditions which tend to hold back the water. An interesting result of this condition is found in the summer time when, following a general rain, the color and taste become more pronounced, due to the washing into the stream of pools formed as a result of low water, where this leaching effect has become exaggerated.

¶ THE USE *of sulphate of alumina or iron absorbs and reduces color, odor and taste.*

Ordinarily sulphate of alumina or iron is used as a decoloring agent, their efficiencies depending on the fact that the reaction between the natural alkalinity of the water and the alumina or iron tends to break the latter up with the formation of alumina or iron hydrates, whose physical properties of weight, insolubility, and the possession of a bulky gelatinous mass, tend to make them absorb and reduce color and the accompanying odor and taste.

In the case of very soft and highly colored waters, such as are found in the East, it is necessary to supply a sufficient alkalinity to decompose the sulphates of alumina or iron in the form of lime hydrate and iron has in almost every case been found to work more efficiently when accompanied with sufficient lime to produce a slight excess of hydrate alkalinity, even tho there be already present in the water sufficient bicarbonate alkalinity. Moreover iron seems to exert more decolorizing and deodorizing power on some waters than alum, as is claimed for its use at a plant recently completed at Fargo, North Dakota, tho alum seems much more generally applicable. Where iron can be used it proves quite desirable, due to the lesser expense of iron as compared to alum.

The total hardness of the water at Grand Rapids has averaged 217 p.p.m with a maximum of 288 p.p.m. and a minimum of 104 p.p.m. This has been accompanied by an average color of 32 and an average turbidity of 20 p.p.m., the color ranging from 16 to 55 and the turbidity from 5 to 135 p.p.m. as minima and maxima. This total hardness was made up of the bicarbonates of calcium and magnesia averaging 188 p.p.m., accompanied by about 30 p.p.m. of sulphates and an average of 17 p.p.m. of magnesium for the past six months.

The first few days of operation showed that the amount of alum necessary to produce a water whose color was 10 or less was excessive, a water carrying a color of 30 to 40 p.p.m. requiring 3 to 4½ grains per gallon of alum to produce a water of the above requirements. Such treatment was not only expensive but so increased the sulphate or permanent hardness as to produce a very disagreeably hard water. Meantime laboratory experiments indicated that the use of lime would not only soften the water but decolorize it as well and at less expense.

¶ LIME *used to remove lime and an explanation of the chemical actions.*

It is oftentimes a puzzle as to why lime is used to remove lime. It is a basic chemical principle that an acid will combine with an alkali to produce a neutral body which is neither acid nor alkaline. Calcium and magnesium salts are largely present in a water by virtue of the solvent action of the carbonic acid gas dissolved in the water and are therefore present in an acid condition. By the addition of an equivalent amount of an alkaline form of lime, calcium hydrate, there is produced a neutral body which is insoluble, and if there should be five parts of such

acid calcium or magnesium present in a water the addition of five parts of calcium hydrate would precipitate out of the water 10 parts of lime which would contain the lime added as well as the lime present in the water. Moreover, magnesium so precipitated has much the same form physically as do the hydrates of alumina and iron and is available for the same uses, as coagulant to remove turbidity or color. It was proposed, therefore, to utilize the magnesium in the Grand river water supply thru the softening process as a decolorizing agent.

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¶ USE *of sufficient lime has reduced the amount of alum, and consequently the unit cost of softening.*

Ordinarily the softening processes can be carried to any point desired up to the full neutralization of all acid lime present. At the Grand Rapids plant, however, it was soon found that unless sufficient lime were added to neutralize completely all bicarbonate or acid alkalinity, the magnesium was not precipitated in a form to be sufficiently available for decolorizing purposes and therefore we were compelled either to soften the water to a point much lower than the 120 or 125 p.p.m. desired or else operate at greater unit cost, in that a partial softening of the water made it necessary to use 2 to 3 grains of alum in addition to the lime to produce a satisfactory color. On the other hand by the addition of lime sufficient for the full neutralization of the bicarbonates present, it was found that we could produce a water whose color was 10 or less and whose total hardness ranged from 88 to 100 p.p.m. for the past six months. By so doing we were able to reduce the alum required to an amount as low as ¼ grain per gallon, its function being largely to help carry down the fine crystals of calcium carbonate formed in the softening process.

From the standpoint of the consumer, this was excellent, in that the water so produced was soft enough to lather freely in the cold and without the formation of the scums that are so disagreeably characteristic of hard water, as well as a water whose color was no longer noticeable. In addition this later method of treatment enables us to operate at a much less cost per million gallons than by the use of alum.

The use of alum, then, offered as an advantage color removal alone and as disadvantages increased cost of operation an increased hardness of the water produced. The use of lime offered as advantages the reduction of both hardness and color at greatly reduced cost as compared with alum, the disadvantages from the operator's standpoint being that once the people of any community become accustomed to a very soft water they also become sensitive to any upward changes of hardness and are therefore liable to notice and object to any increase in hardness later on.

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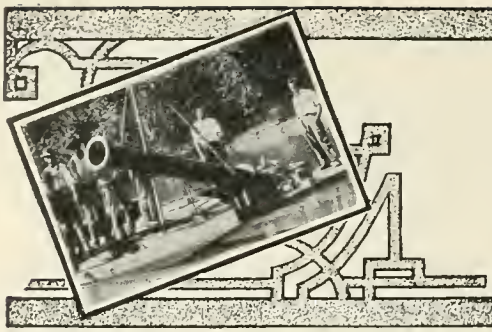
¶ THE *methods in present use are the most economical and efficient for all seasons and kinds of water.*

So far as we have been able to study and observe our problem, this method of treatment with lime has proved most efficient and economical for all classes of waters the seasons have brought to our plant. Whether the color drops to as low as 20, as in the hard waters of the summer time, or rises to 60 or 70 following the spring floods, it requires excessive amounts of alum for its removal, and lime, therefore, proves most efficient, save for those short periods when the total hardness gets as low as 100 to 120 p.p.m. with the magnesium in the water falling off to 10 to 15 p.p.m., at which time alum must of necessity be used.

The average reduction of magnesium in the filtered water, following such treatment as the above, as compared to the river water, has been 25 per cent.



EDITORIAL

THE CURRENT CONVENTIONS

Some rather vexing questions have some new light thrown upon them by the papers at the September and October conventions of associations devoted to public service.

Two of these associations, the New England Water Works and the American Public Health, consider water and health problems. Special attention is called to the papers from Grand Rapids and Brooklyn at the latter association upon the economy of softening water and the corrosion of pipes by various raw and treated waters, as emphasizing points heretofore somewhat neglected, but of increasing importance.

The difficult problem of locating leaks in water mains has two solutions offered in papers before the former association from Boston and New York, which should give considerable aid. These and other important details of practice will be given to our readers in this and subsequent numbers.

Standardization of road and pavement specifications will be greatly promoted by the work done at the conventions of the National Paving Brick Manufacturers' Association in September, the American Highway Association, in session as this number is mailed, and the American Society of Municipal Improvement in October. The first and last named have been at work on this subject for some years and the Highway Association has fully recognized the importance of the technical questions by the large amount of space devoted to them in the program for its Detroit convention. It also devotes much time to the equally important subject of better road legislation.

This seems to be a year of more than usually valuable contributions, especially to our knowledge of the proper treatment of troublesome details and of satisfactory results therefrom.

The Fire Chiefs' Convention in New York in September offered over-

whelming evidence of the economy and efficiency of motor apparatus in fire departments, both large and small, and its contribution to our knowledge was upon the largest scale and upon the largest question, and is consequently of the greatest importance.

DEVELOPMENT IN BRICK PAVING INDUSTRY

The keynote of the Cleveland meeting of the National Paving Brick Manufacturers Association was co-operation. The association and the organizations of municipal officials have co-operated in the past to the extent of preparing standard specifications for brick and for brick pavements and the next step is to secure the co-operation of the city officials generally in adopting these specifications and in employing competent inspectors to carry them out. About one hundred city engineers from cities in Ohio and the states adjacent were present on invitation of the association and had this doctrine presented to them by other engineers and city officials and by ocular demonstration of the excellence of pavements constructed according to the adopted standards for material and workmanship.

It was suggested in the opening speech at the "get-together" banquet that the brick makers follow the lead of Mr. F. B. Dunn in putting engineers in the field to watch the progress of their brick after they have left the plant and offer their services in securing the best results with them. This offer was placed on the basis of the self-interest of the brickmaker, but would evidently give much valuable aid to contractor, engineer and inspector, and would thus be a concrete evidence of the desire of the makers of the material to advance the interests of all concerned.

A small group of members of the committees on specifications of the national societies visited several brick plants and streets under construction and saw the possibilities of preliminary inspection of brick at the plant. They also saw the need of uniformity and good judgment in inspection of materials and workmanship on the street and of workmanship equal in quality to the materials furnished in order to secure good pavements.

The conference will undoubtedly result in the wider extension of excellence in brick paving construction and in improvements of and benefit to the paving brick industry.

QUESTION DEPARTMENT

How to Fill Vacancy in Town Council.

Two of our town council having resigned, leaving three, all effort to get the three to agree upon some man to fill the vacancy has failed, two having been the means to have the other two resign in order to block all progress of the new administration. These two attempted and did elect one of their kind, which has been held by all but one or two attorneys here to be illegal, and our attorney general is in doubt as to its legality. There seems to be no Supreme Court decision on the point. Can you give any information?

R., Mayor, ———, Iowa.

It has been held that a city council cannot elect its own members when the law provides that they shall be elected by ballot by the electors of the city, in Kearney v. Andrews, 10 N. J. Eq. 70. But the Iowa statute, sec. 1272, p. 252, supp. of 1907, definitely provides for the filling of vacancies, in which it says that "in the office of councilman or mayor of any city and all other elective city offices, the council may appoint any qualified elector to fill such vacancy, who shall qualify in the same manner as persons regularly elected to fill such office, and shall hold such office until the qualification of the officer elected to fill such vacancy, who shall be elected at the next regular municipal election; in all town offices, by the council at its first regular meeting after such vacancy occurs, or as soon thereafter as practicable."

As to election of men to fill the vacancies, Thurston v. Huston, 123 Iowa 157, and cases from other states may be quoted as authority for the statement that, if there be no statutory restriction, a majority of a municipal council or board is a quorum, and a majority of a quorum may act. However, par. 2 of sec. 668 of the code provides that "in all cities and towns a majority of the whole number of (council) members, to which such corporation is entitled, including the mayor, shall be necessary to constitute a quorum." With five councilmanic positions and the mayor, four would be necessary to constitute a quorum and three votes would be necessary to secure a majority of that quorum.

Some doubt as to the application of Sec. 668 arises from the fact that Sec. 645 was amended in 1907 so that the mayor is no longer a member of the council, but Sec. 668 was not changed. It would seem that the mayor being no longer a member of the council would not be counted in determining a quorum, but Sec. 668 so requires.

Waterproofing Concrete Reservoirs —Cleaning Water Pipes

Have you any data or information on concrete reservoirs, especially with regard to waterproofing and expansion joints? One here, constructed about a year ago, does not hold water at all. I would also like to know the best methods for removing silt or sand from water pipe. Perhaps you could refer me to some book or paper that would cover these points. M., ———, Ore.

With reference to concrete reservoirs and making them water-tight the following references will be of value:

An article in MUNICIPAL ENGINEERING, vol. xlv, p. 54, on "Cracks in Concrete," gives the reasons for them and methods of preventing them, including the placing of contraction joints.

Methods of making elevated concrete tanks watertight are given in an article on "Construction of Two Types of Elevated Concrete Tanks" in vol. xliv, p. 62. The method of making a 5,000,000-gallon concrete reservoir hold water is indicated in a brief article on p. 79 of the same volume. Results of a test of the effect of a waterproofing compound will be found in an article on "Waterproofing Concrete Test," on p. 375. The method employed in waterproofing a leaky reinforced concrete water tank is described in detail in "Waterproofing Huntington Water Tower," on p. 470.

Three methods of waterproofing a concrete pit where water is coming in from

the outside under the outside pressure are suggested in vol. xliii, p. 175, and a successful method is given on p. 256. "Waterproofing of Swimming Pools," on p. 410, is more directly applicable to the case in hand, if waterproof lining of the existing reservoir is decided upon.

The construction of a covered reinforced concrete reservoir partly buried in the ground is described in vol. xlii, p. 42. In an article on "Economy of Circular Reinforced Concrete Reservoirs," on p. 376 of the same volume, is a description of the method of lining a leaky reservoir and adding to its depth, which resulted in a watertight reservoir of double the capacity. The waterproofing was very simple in this case, depending upon the proportions and mixing of the concrete and a wash of semi-liquid cement on the inside of the tank. A method of mixing concrete with a waterproofing compound is described in an article on "Integral Waterproofing" in vol. xlii, p. 416, and another will be found in vol. xli, p. 322.

Books on the subjects are not numerous. Lewis's "Waterproofing: An Engineering Problem" (50 cents) and "Modern Methods of Waterproofing" (50 cents) are valuable.

Lewis and Chandler's "Popular Hand-Book for Cement and Concrete Users" ($2.50) has a little information on watertight construction and waterproofing.

As to cleaning water mains, the best method, if possible to apply it, is to put in blow-off pipes at the lowest points in the lines with valves which can be opened to flush the mud and sand out into convenient water courses.

There are machines which can be operated to clean out water mains, but openings must be made into the mains at intervals to insert and take out the machine. One such machine is described in MUNICIPAL ENGINEERING, vol. xlii, p. 334, as made by the Turbine Sewer Machine Renovating Co., of Milwaukee, Wis. The apparatus as applied to a sewer is illustrated in an article on "Modern Sewer Cleaning in Milwaukee, Wis.," in vol. xliv, p. 273.

A scraper for water pipes is illustrated and described in vol. xiv, p. 232.

Water pipes can be flushed by opening hydrants, but where the flushing must be done frequently the hydrants to be used should be chosen carefully at the best locations to clean the troublesome sections of pipe. Valves can be set on these hydrant branches so that the hydrants can be removed easily for repair whenever they need it.

Procedure in Passing Ordinance

I would like to have the form of procedure for the passage of an ordinance where rules were suspended and the ordinance passed to its second and third readings at the same meeting, the form to comply with the Iowa statute. L., ——, Iowa.

Section 682 of the Iowa Code provides that "ordinances of a general or permanent nature and those for the appropriation of money shall be fully and distinctly read on three different days unless three-fourths of the council shall dispense with the rule."

The rule can only be dispensed with by a strict compliance with the statutory authority, so that two ordinances could not be included in the same motion, the action in such case being valid only as to the ordinance first named in the motion. Cochran v. McCleary, 22 Iowa, 75. It would therefore be safest to make two motions, one to dispense with the rule and place the ordinance on its second reading and the other to dispense with the rule and place it on third reading and its passage.

In State v. Vail, 531 Iowa, 550, it is decided that it is not necessary that the yeas and nays on a vote to suspend the rules requiring reading on three different days be recorded, and where a sufficient number of members to suspend the rule appear to have been present and such motion is declared adopted, it will be presumed that a sufficient majority voted therefor.

Danger of a similar attack would be avoided, however, by recording the yeas and nays on each of the motions to dispense with the rule as well as upon advancement of the ordinances to third reading and the passage of the ordinance.

In Bayard v. Baker, 76 Iowa 220, it is decided that the word suspend is equivalent to the word dispense, but it will be well to use the word dispense in the motions.

The membership of councils and what constitutes three-fourths of that membership are closely scrutinized and the statutes are strictly construed in such cases as Horner v. Rowley, 51 Iowa 620, and Griffin v. Messenger, 114 Iowa, 99. Section 645 of the code in its amended form provides that in cities the council shall consist of two councilmen from each ward and in town of five councilmen at large. Sec. 668, par. 2, providing that "in all cities and town a majority of the whole number of members to which such corporation is entitled, including the mayor, shall be neccessary to constitute a quorum," was not repealed or amended. These provisions are rather contradictory, but it would again be safer to count the mayor in the number of councilmen in determining the three-fourths vote necessary to dispense with the rule.

Other cases which consider various phases of the matter are: City of Eldora v. Burlingame, 62 Iowa 32; Strohn v.

Iowa City, 47 Iowa 42; Cutcomp. v. Utt, 60 Iowa 156; State v. Omaha & C. B. R. & B. Co., 113 Iowa 30; McGraw v. Whitson, 69 Iowa 348.

Road Construction for Heavy Travel

What is your opinion about hard country road construction As you well know, the modern heavy automobile with its monstrous tires makes terrible inroads on the country roads. Do you not think that these fellows ought to help pay a fair honorarium toward the upkeep of the various state roads? As you well know, a fellow cannot dance unless he pays the fiddler.

W. J., Aurora, Ill.

There is hardly a number of MUNICIPAL ENGINEERING which does not advocate hard pavements for the main roads, its theory being that the roads must be built to suit the traffic, and that the traffic on the main roads demands the best and most permanent wearing surfaces.

All of the items in the following statement have been elaborated in recent articles too numerous to mention in detail.

Such gravel and macadam roads as have been constructed in many states under the county and township systems, notably Ohio and Indiana, are sufficient for the local traffic about the farm, from farm to farm or from farm to main road, and it would be a waste of money to build them of better material. The automobile, if run at a proper speed, is a benefit rather than a damage to such roads, and a speed limit should be strictly enforced for all motor vehicles on such roads.

There is a class of what may be termed secondary roads which requires a somewhat heavier construction than the neighborhood roads and will demand this better construction more strongly in the future as the automobile truck develops as a carrier of farm products to market. These roads require heavier foundations and, on account of the likelihood of greater speed of vehicles, require some binder to keep the wearing surface in position and prevent the formation of dust. Various forms of bituminous treatments, bituminous macadam or bituminous concrete are suitable for most of these roads. These roads are worn out by general travel and the automobile rider from without the district does his full share of wearing them and he should pay his share of the expense of building and maintaining such roads, to be paid by the county and state from the proceeds of general taxes and automobile license fees.

There are a few main lines of road over which the traffic is now so heavy or will be so heavy as soon as the road is good enough to stand it, that only really good pavements, such as brick, cement concrete, or the best bituminous concretes are economical, when the first cost and the cost of maintenance are both considered. It is fairly evident that such roads enhance the value of abutting property, so it should pay a part of the cost of construction at least. However, much the greater part of the wear as well as practically all the necessity for so good a road arises from the traffic from territory not adjacent to the road, but even nationwide, so it is equally evident that this traffic from outside and those who benefit from it should pay much the largest share of the cost of construction and maintenance. Contributions from county and state, derived from taxes, vehicle licenses, etc., are the only practicable means at present available for distributing this cost in any proportion to the uses made of the roads. It may even be contended that the United States should pay a certain proportion of the cost of thru routes of travel.

The automobile can be assessed more than any other vehicle because much of the demand for the best construction comes from the automobile users and their extended tours both for pleasure and for business. The automobile truck traffic is not yet as insistent in its demands, but its turn will come within two or three years, requiring stronger bridges, stronger road foundations and better road surfaces than gravel, macadam or like materials treated with bituminous materials by the so-called surface methods.

The wear upon the softer surfaces increases more rapidly than the speed of motor-driven vehicles, and probably more rapidly than the weight on motor trucks, so that it is certainly fair to assess such vehicles in proportion to possible speed and weight. The simplest method of covering both is to make the assessment in proportion to actual horse power available, as this is roughly proportioned to possible speed for the passenger vehicles and to possible weigbt for trucks. Motorcycles should be assessed in a different proportion to horse-power, because their speed is so much greater for the same horse-power than that of the four-wheeled automobile.

Proper Construction of Macadam Street with Concrete Curb and Gutter

I am interested in the making of waterbound macadam in a small city. I believe they are not doing substantial work. When the contractor rolled the macadam he spread and lifted the combination concrete curb and gutter, breaking it so that it had to be replaced. I am submitting a list of questions concerning methods of construction, and it may be you can cite references to articles already published on this subject.

1. Should the subgrade be rolled and to what extent?
2. If soft places are found in the sub-

grade is it worth while to dig out and replace with better material?

3. Is there any form of concrete combination curb and gutter that will hold its line and grade when the macadam is being rolled before placing the crushed stone?

4. Is it very material that the subgrade should be brought to a true and even surface by filling holes and dressing off humps before placing macadam?

5. Should the voids in the macadam be completely filled and how is the best way to accomplish this?

6. Can the binder or filler of limestone screenings be placed on top of 8 inches of macadam and be successfully rolled down thru, so as to fill the voids; or should it be mixed in two layers?

7. Should macadam be rolled wet or dry?

8. About how many days on the average should be required to properly roll a stretch say 26-ft. wide by 600-ft. long?

9. If there is a fill of over 1 foot should the filling be rolled in several layers with a steam roller? W., ———, Wis.

1. Ordinarily the sub-grade must be rolled. The weight of roller and the amount of rolling depend upon the character and condition of the sub-soil. In some cases a comparatively light roller produces better results than a heavy roller. In any event the rolling must be continued until the sub-grade is compact and to grade, uniformly thruout. The quotations of specifications made in the answers to the various questions are made from those adopted by the Association for Standardizing Paving Specifications and are styled the standard specifications. With reference to rolling the standard specifications provide as follows:

"Said completed surface, (after excavation) shall conform to the general cross-section of the street as indicated and shall be thoroly cleaned, all stumps, roots and sod or other vegetable matter removed, and the sub-grade shall be rolled with a steam road roller weighing ten tons, so the surface shall be exactly parallel with the proposed finished surface."

2. It is quite necessary to dig out soft places and replace with better material. This is especially true where trenches for water, sewer, conduit, etc., have been put thru the street before paving, and some specifications require that the rolling shall be done across the street as well as lengthwise in order to develop all soft places.

Professor Baker in his standard work on "Roads and Pavements," ($5), recommends, where the integrity of the pavement demands it, that trenches which settle under the rolling shall have the volume left after thoro consolidation filled with broken stone thoroly rolled to place or with concrete. The standard specification reads:

"All soft or spongy places shall be excavated and re-filled solidly with gravel, broken stone or approved earth before the completion of the rolling."

3. If the sub-grade is completely consolidated and the foundation and the earth behind the curb are consolidated as they should be, movement of the curb during the process of rolling is probably due to wrong methods of handling the roller. In very soft ground it would be difficult to hold the curb and gutter exactly to place, but in any ordinary ground on which a pavement may be expected to keep its place, the curb should keep its place. The standard specification reads as follows:

"The rolling herein specified must be generally begun at the curb or gutter line and rolled from curb to crown, the shoulders first being rolled so as to prevent the spreading of the stone."

The standard combined curb and gutter is 12 inches deep on the outside and extends 6 inches below the surface of the pavement plus whatever transverse slope is given the gutter surface. The broken stone, gravel, or cinder foundation of the curb should extend to or below the level of the sub-grade of the pavement.

4. The quotations, taken from the standard specifications, given above, provide first for the dressing of the surface until it is smooth and parallel to the finished pavement surface, and second for the rolling and dressing of this surface until it is thoroly compacted, smooth and parallel to the finished pavement surface. This is necessary that the pavement and its foundation be as uniform as possible, so that there shall be no unequal settlement or consolidation of either under traffic. The essential requirement of a macadam pavement is that holes shall not form in it, but that it shall keep a uniform surface. This is impossible if either compacting of foundation or compacting of the stone layer or hardness of the stone layer in place is not uniform.

The above sections were amended at a later convention to read as follows, making the requirement of character and form of surface still more exacting:

"The full width of the road-bed shall be brought to the proper line, grade and cross-section indicated on the plans by excavating, filling and thoroly rolling with an approved road roller weighing at least 10 tons; all soft or spongy ground shall be removed and refilled with gravel or other approved material which will pack, and the rolling shall be continued until the roadbed is thoroly consolidated and shaped to the satisfaction of the engineer. A wooden templet shaped to the proper size and crown of — inch per foot from center to side, or other equally satisfactory method, shall be used to obtain the required contours of all the courses. *Note.* The crown may be from ⅜ to ¾ inch per foot to be determined by the engineer for each particular case."

5. The standard specification deplores

the variety of specifications of sizes of stone and layers and suggests the following, the stone being separated by screening thru stone screens with circular openings ⅝-inch in diameter producing screenings, 1 inch in diameter, producing so-called ⅝-inch stone, and 3 inches in diameter producing so-called 2-inch stone, and using all the product of the quarry except that refused by the largest holes.

"The lower course shall consist of run of crusher stone which shall pass a 3-inch and be retained on a 1-inch screen. The stone shall be laid upon the properly prepared foundation to a depth of 4 inches when completed. The depth of the loose stone in all cases shall be fixed by laying upon the sub-grade cubical blocks of wood of the proper size and spreading the stone evenly to conform thereto. This course shall be thoroly rolled until the stone does not creep or wave ahead of the roller. Stone screenings or sand shall then be uniformly spread over the surface in small quantities by shovels from carts or piles of filler alongside the road and the rolling continued, sweeping in the screenings meanwhile until no more will go in dry, when the surface shall be well sprinkled by an approved sprinkler to fill the voids, screenings being added where necessary and the rolling continued until the surface is satisfactorily finished. No filler shall be left on the surface, but the surface shall be left with the clean stone projecting for a bond, leaving the lower voids thoroly filled. *Note.* Upon a poor foundation or where a finished depth of stone of more than 4 inches is deemed advisable, the stone shall be laid in two layers and treated as above described. Good results may be obtained without filling the voids in the lower course, but upon a sandy soil or a well-drained roadbed better results seem to be obtained by thoroly filling the voids in the stone. Stone screenings, sand, or other suitable material may be used as a filler. Good results may be obtained by a sand filler, and results are also obtained when a small quantity of stone screening dust is used on top of the sand to fill the voids in the sand. The voids may be filled without application of water if all the materials are dry; but a firmer foundation seems to be secured when the course is well puddled with water. In some cases properly screened gravel may be used as a bottom course and as a filler in the top and bottom courses."

6. The specification just quoted also answers the sixth question, in effect that if the macadam is to be 8 inches thick it should be laid and rolled in two 4-inch layers and each layer filled with screenings or only the top layer.

7. The seventh question is also answered by the above quotation, providing for dry rolling followed by wetting and rolling.

8. The amount of rolling depends so much on the kind of stone, hard stone requiring more time, the amount and kind of filler required and the amount of water used that no figure of direct application can be given. Applied to the data given for length, breadth and thickness, actual measurements on jobs show variations from 3 to 27 days' time required, the average being about 6 days, but this average may be quite different from the time required on any one job.

9. The more thoroly a fill can be compacted the better. The New Jersey specifications provide a maximum thickness of layer to be rolled of 12 inches. Again the thickness of layer and the amount of rolling depends so much upon the kind of earth used in filling and its condition, particularly as regards moisture, that this specification for New Jersey sandy soil might not suit the soil in the particular case.

Drainage Water in City Sewer

I have received the following communication:

"I have eighteen acres of land drained by farm tile, which empties into the city sewer. This 7-inch tile runs a small stream of water into the sewer all the year. From your practical knowledge of such things, would you say this water was an injury or a benefit to the sewer? I am thanking you in advance for a line or two expressing your opinion."

So far as our experience goes we believe the introduction of clear water, in reasonable quantities, would be a benefit to the public sewer system operating under conditions which prevail in most Illinois cities of 5,000 to 10,000 population.

What, from your experience and observation, do you think of the proposition?

D., Mayor, ———, Ill.

In cities of the size mentioned a constant discharge of clear water into the sewer is a benefit rather than a damage, provided purification of the sewage is not required. In that case the demand is for as small a flow as possible, that the expense of the process of treatment may be as low as possible.

At times during the day the flow of sewage is probably slight and, especially in the branch sewers, there is possibility of collection of solids enough to obstruct the sewer, and flush tanks are supplied in some systems to give intermittent streams of clear water of considerable volume.

It would be possible, of course, to overload the sewer with the stream of clear water, but, up to that point, the clear water is a benefit. To insure provision for future increase in amount of sewage, any permit to use it for drainage purposes should be revocable at any time.

WORKERS IN THE FIELD

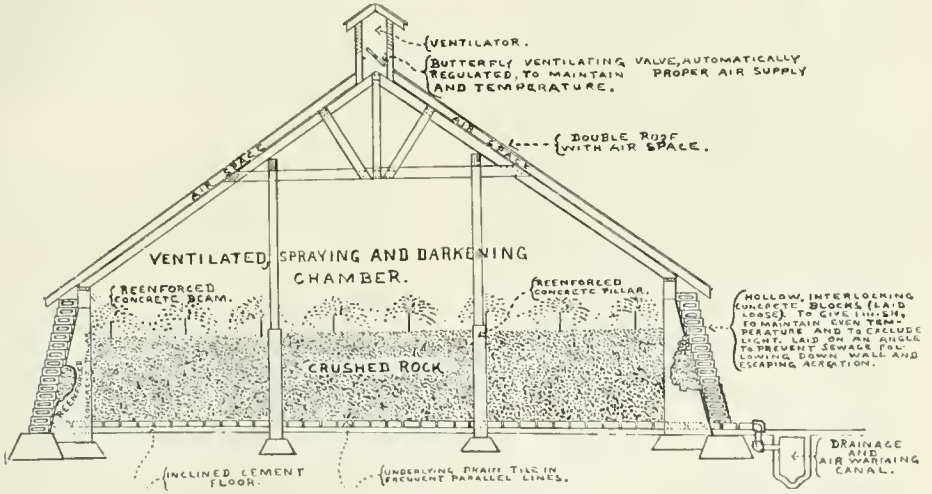
Suggestions for Improvements on Bacterial Filtering Beds for the Purification of Sewage

The Editor of MUNICIPAL ENGINEERING:

Sir—After a careful study of sewage purification for Pasadena, I would like to make the following suggestions public through your pages. They may possibly be of use, especially where the climate is less equable than here.

These suggestions apply to a filtering bed of the usual construction for the purification of sewage, consisting of an inclined concrete floor on which is a series of parallel rows of drain tile over which is a bed of broken rock or other mineral material in pieces of graded sizes, and placed above the broken material are sprinklers or other means of applying the sewage effluent of the Imhoff settling tanks in a regulated and approximately even manner over the entire surface of the bed.

1. Over the bed of crushed mineral material, an enclosed "ventilated spraying and darkening chamber" in which said sprinklers are located as shown in accompanying drawing. The purposes of the proposed chamber are: a.—To maintain the desired equability of temperature on the surface of the bed of filtering material; b.—To regulate the air ventilation of the bed; c.—To control the admission of sunlight on the surface of the bed; d.—To protect the bed against any unusual washing by rain, the object of the chamber being to maintain conditions best suited to the bacterial growths necessary for purification of the sewage-effluent.


VENTILATOR.
BUTTERFLY VENTILATING VALVE, AUTOMATICALLY REGULATED, TO MAINTAIN PROPER AIR SUPPLY AND TEMPERATURE.
DOUBLE ROOF WITH AIR SPACE.
AIR SPACE
AIR SPACE
VENTILATED, SPRAYING AND DARKENING CHAMBER.
REENFORCED CONCRETE BEAM.
REENFORCED CONCRETE PILLAR.
HOLLOW, INTERLOCKING CONCRETE BLOCKS (LAID LOOSE) TO GIVE LIMITED TEMPERATURE AND TO EXCLUDE LIGHT, LAID ON AN ANGLE TO PREVENT SEWAGE FOLLOWING DOWN WALL AND ESCAPING AERATION.
CRUSHED ROCK
RECEIVING TANK
DRAINAGE AND AIR WARTIAING CANAL.
INCLINED CEMENT FLOOR.
UNDERLYING DRAIN TILE IN FREQUENT PARALLEL LINES.

SUGGESTION *for ventilating, warming and darkening filter beds to supply uniform conditions and stimulate bacterial action.*

2. In the "ventilated spraying and darkening chamber," an automatic thermo regulating device for operating a ventilating valve or damper. The purpose is to open the valve further when the chamber

is warmer than necessary and to close it further when the temperature of the chamber falls below that under which bacterial life is most active; always bearing in mind the fresh air needs of such bacteria. The device should, of course, be so adjusted in regard to temperature and ventilation as to produce the best average results. However, to effect a finer adjustment of ventilation and temperature, it is suggested that an automatic air-warming device be installed. This would permit the temperature and ventilation to be regulated more independently of each other. In this case, the air-warmer would be regulated by the temperature of the chamber, while the ventilating valve, instead of being regulated by the natural temperature of the chamber, would be governed by the velocity of air escaping thru the ventilators.

3. An automatically regulated air-warming mechanism for the "covered, ventilated drainage and air-warming mechanism" is for the purpose of maintaining a more ideal temperature in cold weather at the base of the filtering bed. The ends of the parallel lines of underlying drains are extended into the canal, and thru the latter the air needed for bacterial growth passes into the drains and rises thru the mass of broken mineral material into the "ventilated spraying and darkening chamber," thence escaping into the open air thru ventilators in the roof.

The action of such a filtering device doubtless would have greater capacity per cubic yard of crushed contact material, and would be more uniform and reliable in its action. Much of the chance for odor, such as occasionally develops in filtering beds of ordinary construction when the bacterial action is disturbed and weakened by unfavorable weather conditions, would, it is fair to assume, be eliminated by the use of a filtering device where conditions for bacterial growth are kept constantly normal. To overcome this occasional odor is one of the main purposes of these suggestions.

In preparing a filtering plant of this kind, it might be better to have the depth of broken rock somewhat greater than usual and the rock particles slightly larger in size. This plan will give slightly freer ventilation, while the active contact surface would not be diminished. If the air is warmed in cold weather, this freer ventilation will not result in cooling the mass of rock to a point where bacterial action would be retarded.

If what is above described has already been tried, information regarding the experiments would be thankfully received by the writer of these suggestions.

WILLIAM THUM.
Pasadena, Cal.

Better Inspectors Needed in Chicago

The Editor of MUNICIPAL ENGINEERING:

Sir—The committee on downtown streets of the Chicago Association of Commerce is co-operating with the Board of Local Improvements of the City of Chicago in securing the best possible quality of work for the money expended. Whenever we detect defects in paving material or construction we immediately report same either to the inspectors in direct charge of the work, or in case of more serious errors we make report to the Board of Local Improvements at the city hall. In this work cordial relations have been established.

If all of the work now contracted for and contemplated is completed during the present working season, the city of Chicago will have exceeded all previous records for paving construction. It is estimated that there are about 150 miles of pavements to be constructed during the working season. In 1911 the city of Chicago constructed about 130 miles of pavements. With so many miles of pavements being constructed each year, one may well wonder when the time will come that all of Chicago's streets will be paved. The answer is, "Never." At present only about one-half of the streets of Chicago are paved. Long before the unpaved ones can be improved a large number of those now paved will have worn out, so that each year Chicago will have to construct many miles of pavements to take care of its ever-increasing traffic.

INTELLIGENT inspection essential to good pavements. In order to secure competent inspectors they must be well paid and assured continuous employment.

One of the greatest difficulties in the way of securing the best paving construction possible in Chicago is its method of inspection or supervision of the work. The proper construction of a pavement is dependent almost entirely upon the work of the sub-inspector. The general inspector, because of the fact that he has a large district to cover, can spend but a short time upon any particular piece of work. This being true, it is necessary that the sub-inspector be a man of intelligence with a thoro understanding of the technic of pavement construction It goes without saying that such men cannot generally be obtained without the payment of an adequate compensation and the assurance of steady employment, so that each man may have an interest in his work and with a knowledge of the security of his position show a proper independence of spirit.

The plan now followed in Chicago violates these fundamental requirements. In the first place, while the compensation received by the inspectors would be adequate if they were employed for the full year, it is totally inadequate because of the fact that the men are only employed during the paving season, which means that they actually work about seven months a year. In the second place, while the men are nominally under civil service, the real object of civil service is defeated by the "sixty-day appointment rule," which allows the alderman the right to certify any man for employment as paving inspector for a period of sixty days. This sixty-day appointee is required to take no examination or in fact know anything about paving construction. At the end of sixty days the appointee may take an examination for paving inspector. Even tho at the end of sixty days he may pass the examination for paving inspector, think of the mistakes he may have made in the meantime, for all of which he is being paid by the city.

To secure the best results it is our opinion that the city must raise the requirements of paving inspectors, provide them with yearly employment, and abolish the "sixty-day appointment rule." There is nothing about the present plan which will attract good men or which will tend to keep good men in the service. Many inspectors simply regard their work as a job to be held until some better opportunity occurs.

L. A. Dumond, Engineer,
Chicago Association of Commerce.

New Jersey Requirements for Sewerage and Water Supply Plans

The Editor of Municipal Engineering:

Sir—At a recent meeting of the Board of Health of the State of New Jersey, a set of rules and regulations governing the submission of designs for water works or sewerage works were adopted. These rules have been under consideration for about a year, and the necessity for them has increased daily. Plans are submitted at the present time in all sizes up to 6 feet by 10 feet, and on all kinds of paper from the wrapping kind up to tracing cloth.

It is also an unfortunate circumstance that some few engineers who have worked along other lines will accept work designing municipal sewage disposal or water purification plants apparently without investigating the underlying principles as thoroly as is desirable. It then becomes necessary for the State authorities to gather detailed data regarding the project, which very often cannot be done as efficiently as would be best, because of the small number of engineers which may be employed with the present annual appropriation.

The present rules are therefore intended to prevent loss of time incident to the collection of fundamental data, upon which the design is based, and also to make the plans and reports more uniform in character.

Before taking final action upon the regulations they were submitted to several of the leading sanitary engineers, with the request that comments and criticisms be made. It was the intention of the board to see that no unjust provisions should be included which would cause unnecessary expense or hardship upon the part of the engineers. Many helpful suggestions were made by these engineers, and the board desire to express their appreciation of the time and trouble which were taken in making the replies.

The regulations were prepared by C. G. Wigley, engineer of the board, under the supervision of R. B. Fitz-Randolph, chief of the division of food, drugs, water and sewerage, and adopted by the board of health of the state of New Jersey, June 23, 1913.

R. B. Fitz Randolph.
Chief of Division of Food, Drugs, Water and Sewerage, State Board of Health, Trenton, N. J.

RULES and regulations to be followed in the preparation of designs for sewerage and water supply systems.

An abstract of the "rules and regulations for the preparation and submission of designs for sewerage systems and sewage disposal works and water supply and water purification systems" follows, showing the more important requirements, and may serve also in some measure as a guide in preparing designs, plans and specifications where the state does not have close supervision of such matters:

The plans for a complete sewerage and sewage disposal system shall include:

A general map of the municipality or sewerage district.

Profiles of all sewers proposed.

Details of construction of manholes, flush tanks, and special structures pertaining to the sewers.

General and detailed plans for disposal works.

A comprehensive report upon the proposed system by the designing or consulting engineer. This report to be typewritten upon letter-size paper, and the sheets firmly bound together.

The general plan scale shall be from 100 to 300 feet to 1 inch, and shall show the entire area of the municipality or

district. If the municipality is greater than two miles in length the map may be divided into sections, the sheets bound together and a small index may supplied.

This plan shall show all existing or proposed streets, the surface elevations at all street intersections, and contour lines at intervals of not more than 10 feet.

If it is intended to defer the construction of sewers in some of the streets, the plan shall show that sewerage facilities are provided for all such sections of the municipality or sewerage district. The plans shall also clearly show the location of all existing sewers, either "separate" or "combined," the location of the disposal works, and the location of existing and proposed sewer outlets or overflows. The true or magnetic meridian, the town or borough lines, title, date, scale, direction of flow and average water elevation of the stream shall also be clearly shown. The elevation of the highest known freshets at the outlets and site of the disposal plant shall be given. Any area from which sewage is to be pumped shall be shown by light shading, coloring or other distinctive marks.

Profiles of all sewers over 8 inches in diameter and of all 8-inch sewers, where gradients less than that given below are used, shall accompany the application.

STANDARDS for the making of profiles, detail drawings, reports, etc., for sewers.

Profiles of sewer lines shall be prepared and drawn to such a scale as to clearly show the structural features of the sewer. For ordinary use, the following scales are suggested: Vertically, 10 feet to 1 inch; horizontally, 100 feet to 1 inch. Both scales must be clearly shown upon each sheet. Upon these profiles shall be shown all manholes, flush tanks, lampholes, siphons, and stream crossings, with elevations of stream bed and normal water. Figures showing the sizes and gradients of sewers, surface elevations, sewer inverts, etc., should be shown with the same frequency as required for the map.

The following gradients for sewers flowing half full are suggested as minimum grades for ordinary use, as with careful construction a theoretical velocity of approximately 2 feet per second can be obtained:

Size of pipe.	Fall in feet per 100 feet of sewer.
8 inches	0.40 feet
10 inches	0.29 feet
12 inches	0.22 feet
15 inches	0.16 feet
18 inches	0.12 feet
20 inches	0.10 feet
24 inches	0.08 feet

The sewers should have a capacity when flowing half full sufficient to carry twice the future average flow twenty-five years hence, plus a sufficient allowance for ground water infiltration.

When grades lower than those given are used, an explanation and reasons for the use of such grades should be included in the engineer's report.

Detail drawings of sewer sections except where terra cotta or iron pipe is used, and of all sewer appurtenances, such as manholes, lampholes, flush tanks, inspection chambers, siphons and any special structures, shall accompany the general sewer plans.

The plans for the disposal works shall include a general plan upon which reserve areas or future extensions are clearly shown, and detail plans of the various units and structures which comprise the plant.

A weir or other measuring device shall be provided at some convenient point, and the installation of a recording device is recommended, and in particular instances may be required.

The detail plans shall show longitudinal and transverse sections sufficient to explain the construction of each unit. They should also show the distributing and drainage systems, general arrangement of any automatic devices, sizes of stone, gravel, or sand used as filtering material, and such other information as is required for the intelligent understanding of the plans.

All drawings submitted shall be neatly and plainly executed and may be traced directly on tracing cloth, printed on transparent cloth, or printed on any of the various papers which give distinct lines. All prints shall be clear and legible.

With the exception of the map, the following dimensions are suggested for ordinary use: Distance from top to bottom, 20 or 30 inches; length, 24 inches, 32 inches, 40 inches or 48 inches, or thereabouts. By this section it is intended to prevent the use of long profiles and unnecessarily large maps, which are difficult to file or to use.

A report, written by the designing or consulting engineer, should accompany all plans for complete sewerage systems, and shall give all data upon which the design is based, such as:

The nature and extent of the area which it is proposed to include within the present system of sewerage, and of the area which it is planned shall ultimately drain into this system.

The population to be served, both present and estimated for twenty-five years hence.

The estimated per capita daily flow of sewage to be cared for.

The total and per capita water consumption of the town at the present time.

The allowance made for leakage into the sewers.

The estimated daily flow of sewage, including leakage.

The character of the sewage (whether domestic or including manufacturing wastes, and in case of the latter, the nature and approximate quantity of the same stated in specific terms).

Method of flushing or periodically cleaning of sewers.

That portion of the sewers to be built at the present time.

The minimum grades of sewers for each size used.

If there are sections which cannot drain into this system, the extent of such sections and the probable future disposition of the sewage from these sections.

Distance of sewer outlet from shore and depth of water at mean tide at outlet, if outfall discharges into ocean or large stream.

A list of bench marks or fixed elevations should be included in this report.

RULES for design of sewage disposal plants, with full instruction for procedure in collection of data.

With regard to the disposal plant, the engineer's report shall cover the following subjects:

The method of disposal to be adopted and a description of the units of the system.

The rate of working of each unit.

If disinfection is to be used, the name of the disinfecting substance, the quantity per million gallons of sewage and the method of application.

The nature of the body of water into which the effluent discharges, with particular reference to the run-off during dry weather.

The disposal of sludge.

All conditions peculiarly characteristic of the locality and which in any way affect the design of the system.

Special devices used in connection with the disposal system.

Specific methods of maintenance or operation of the system.

The results expected from the purification system.

Explain any provisions for reserve units in pumping plants, pipe lines, filters, etc.

Specifications for the construction of the system of sewers and sewage disposal works and an estimate of the cost of the same shall accompany plans.

Under ordinary circumstances the board will approve such plans only when designed upon the separate plan, in which all rain water from roofs, streets and other areas and all ground water, other than unavoidable leakage, is to be excluded.

No by-passes which may allow raw or partly purified sewage to be discharged from the sewers or disposal works shall be included in the plans, except by special permission of the board.

No deviation from approved plans shall be made, unless amended plans, showing such proposed changes, have been submitted to and approved by the board.

The rules governing submission of plans for water supply and water purification systems are similar, the most important provisions applying only to water supplies being as follows:

A report, written by the designing or consulting engineer, shall be presented with all plans for complete systems, and shall give all data upon which the design is based or which is required for the complete understanding of the plans.

Where a purification or treatment plant is to be constructed, a measuring device shall be provided at some convenient point, and the installation of a recording device is recommended, and in particular instances may be required.

If no purification process is provided, the nature and extent of the watershed, with special reference to its sanitary condition, shall be fully and explicitly discussed, together with proposed methods and regulations for the prevention of accidental or other pollutions.

A small scale map of the watershed, showing the roads and the number and character of buildings, shall be included in the report. Other features which should be discussed in the report are: Storage capacity, average depth, general nature and area of the storage reservoir, liability of odors or tastes in supply, and removal of color, iron, or hardness.

If the water supply is to be taken from wells, describe the number, depth, size and construction of the same; method of pumping, capacity of pumps, kind of strainer used, nature of ground thru which wells will be driven, and probable flow of the wells. If collecting galleries are to be used, describe their construction.

INFORMATION required for design of water purification plants.

The following information is required respecting the purification plant: The method of purification and a description of the units of the system; the rate of operation of each of the systems; the rate of operation of each unit of the plant; if any chemicals are used, the nature and quantity of each with a description of the appliances for adding the same to the water; a description of all conditions peculiarly characteristic of the water or lo-

cality which in any manner affect the design or operation of the system; a description of all special appliances used, any special methods of maintenance or operation of the plant, and the extent of purification expected or guaranteed.

If for purposes of fire protection it is necessary to provide by-passes, by which partly treated or raw water can be turned into the mains, they shall have valves upon them of such a character that they may be properly sealed by the state board of health. These valves shall not be opened except in accordance with the provisions of Chapter 317, Laws of 1912.

The report should further include a description of the nature and extent of the area to which it is proposed to supply water, or which will ultimately be supplied from the system, the quantity of water to be supplied daily, and the population to be served, the portion of the system to be constructed at present and the minimum depth of pipe below the surface of the ground. A description of any provision for future units of pumping plants, filters, etc., should be given.

Should there be areas in the municipality or district which, on account of topography or for other reasons cannot be supplied with water, a definite statement to this effect must be made and the probable future supply of this omitted territory should be discussed.

Removal of Projections Over Sidewalks in Chicago

The Editor of MUNICIPAL ENGINEERING:

Sir—Until recently there were many show-cases, fruit stands and projecting board signs in the central business section of the city, commonly called the "loop" district. We have caused the removal of all of these and of all obstructions of like character in the downtown section outside of the loop, and in outlying business centers where such obstructions could be construed as nuisances.

We do not issue permits for stands to be placed within the street lines in the loop district, nor in outlying business centers where such structures would interfere with the passage of pedestrians on the sidewalks.

We do not issue permits for any projecting signs other than electric in any part of Chicago. Projecting electric signs are provided for by ordinance, in compliance with which we approve applications and the city electrician issues permits. However, we forbid the erection of projecting signs of any kind on State street between the Chicago river and Harrison street, and on Madison street between the lake and the Chicago river.

An ordinance provides that canvas awnings must clear the sidewalk by at least 6½ feet. This ordinance is rigidly enforced. There are few awnings in the section of Chicago bounded by the river on the north and west, the lake on the east, and 12th street on the south.

The worst form of sidewalk obstruction with which we have to deal is one we inherit from the architects who planned the rebuilding of the city's business blocks after the great fire of 1871. Many, in fact most, of the old buildings are so constructed that the lower floors are below the grade of the walks. The buildings are built to the street line, and to reach these "half-basements," as we term them, an area of four or more feet is cut from the walk adjoining the building. The same condition prevails where basements of old buildings are used for business purposes. The custom of a few years ago was to make one floor below the street grade an income producer for the property owner.

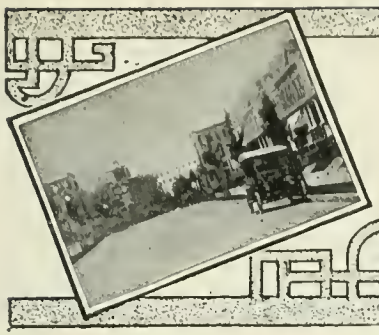
When an old building is remodeled we compel the owner to construct the front so that these areaways are closed, and the full width of sidewalk space is restored for use as such by the public. We do not issue permits for such use of walk space in front of new buildings. Modern buildings are all constructed so that the full width of walk, unobstructed by either depression or riser, is available for passage by the public.

There is an order of the city council which provides that all obstructions on walks in the loop district must be removed before January 1, 1915. We will during next year serve notices on all owners of projecting windows, areaways, risers, etc., to comply with the provisions of this order, and believe that the enforcement of its terms will greatly facilitate foot traffic and add to the comfort of this city.

F. W. SOLON.
Superintendent of Streets, Chicago, Ill.

Sanitary Drinking Cup

The department of health of Harrisburg, Pa., has approved of a paraffined paper drinking cup, which has a flap which can be inserted in a slot, and thus close the folded cup so that dust cannot get into it. The cup is then put in a small paper envelope and can be carried in the pocket. Thus the cup can be used several times before it wears out. On the outside of the envelope is printed, "Drink from your own cup and avoid contagion. This sanitary drinking cup can be used many times. Use it and assist the Department of Health, City of Harrisburg, Pa., to prevent diseases."



ROADS AND PAVEMENTS

Manufacture of Paving Brick from Furnace Slag.

An extensive industry is being developed in the north of England, at Middlesborough, in making paving brick of blast-furnace slag, several companies being engaged in the work and apparently very successful.

A suitable manufacturing site is connected by an industrial railway upon which the molten slag is carried from the furnace to the molding machine. The latter consists of a metal wheel which may be of any suitable diameter, approximately 30 feet, this wheel being supported upon a vertical shaft. The spokes of the wheel are made of rods and the wheel itself is quite similar to the wire-spoked wheel used for vehicles. The rim upon which the molds are bolted is approximately ¾ inch thick and 6 inches wide, and carries 120 molds, 9 inches long, 3½ inches thick and 4 inches deep, which is the standard size for paving brick. The molds are made of two pieces, the front end or right side being an arm in one piece which is bolted to the rim of the wheel, while the left side, back end, and bottom is another piece. The latter is hinged to the part which is secured to the rim of the wheel and held for casting purposes by a catch on the front end of the stationary piece. On the right side of the mold is cast a lip which assists the operator in more readily striking the mold when pouring the hot slag. Before casting, the molds are dusted with a cement powder.

The car which carries the slag is of plate steel with a firebrick lining, the top being covered over with a removable cap, in the center of which is a hole approximately 18 inches in diameter, thru which the slag is poured when the car is filled at the furnace. At the bottom of this car is a tap similar to those used upon blast furnaces. The car of molten slag is run alongside the wheel, the trough to the tap extending over the molds; the clay plug in the tap is knocked out and the molten slag runs into the mold. As soon as it is filled an operator, by means of a handwheel mounted upon a sheet-steel heat deflector and connected thru rods and miter gears to the center of the molding wheel, turns the latter so that the next mold comes under the flow of hot slag, and so on until all the molds are filled. By the time the wheel has made a quarter revolution the cast brick have sufficiently cooled so that they may be dropped out of the molds by knocking off the catch which holds the bottom in place.

As soon as they have dropped to the ground they are taken by laborers to the annealing furnaces, into which they are thrown in a promiscuous heap. These furnaces, of which there are six, hold approximately 1,100 brick at one charge. The heat retained in the brick when they are thrown into the furnace, together with a very small amount of fuel, again brings them to a cherry red, and as soon as the furnace has been filled it is closed and allowed to cool gradually, twenty-four hours usually being required before the bricks are removed.

The capacity of the slag car is approximately 3½ tons, from which 360 to 400 paving bricks are made. The bricks, when cleaned up, having all of the rough corners knocked off which have been left in the process of casting, weigh about 14 pounds each. These bricks are proving very efficient for street paving and are being exported to the United States, Canada, and many other foreign countries.

Concrete Road Organization

By G. F. Haskell, The Concrete Construction Co., Cedar Rapids, Ia.

A good plan of organization for carrying on concrete road work is to divide the work into two parts, each under a competent foreman or superintendent, the first party to do the grading, prepare the subgrade carefully and haul the aggregate on the road bed in such quantities that there will be sufficient to provide for the concrete. It is better, however, to have

slightly less than too much aggregate in the roadway, as it is more economical to haul in an extra load or two to make up any deficiency that may occur than to dispose of a surplus.

It should be borne in mind for estimates for this part of the work that there will inevitably be a small amount of aggregate left on the road bed, which is by no means a bad feature, so that there should be allowed a full cubic yard of gravel or stone for each cubic yard of concrete to be laid.

The second party comes upon the work with the concrete mixer and starts in at

STREET *paving in Clarinda, Ia., work being done by the Concrete Construction Co., Cedar Rapids. Koehring street paving mixer in foreground.*

one end of the road to mix and place the concrete. With an automatic distributing boom type of machine five to seven men will be about all that can be used advantageously in shoveling the material into the hopper. Two men will be required on the machine, one man to clean up as the machine advances so that the concrete may be placed on a clean roadbed; two or three men taking up the forms as used and putting them ahead; three men to strike the work, using the template and two men finishing with floats. Parties so made up, with a 12-foot capacity mixer, will ordinarily lay from 500 to 800 square yards of 7-inch concrete a day of ten hours; 500 yards can be laid with a comparatively untrained crew, or a trained crew should handle 700 or 800 yards. The teams necessary for this part of the work would be only those required to haul the cement and an occasional load of gravel as deficiency may be experienced.

There are sections of the country where continued sultry summer weather prevails when it will be necessary to work the shovelers in two gangs, working from fifteen to twenty minutes each. Either this must be done or the progress of the whole party reduced to about one-half what it is in cooler weather.

A third party might be organized to trim the shoulders and attend to final finishing of the side roads and ditches.

In those sections of the country where the rainfall is plentiful and well distributed thruout the year, it will be found that the actual number of working days in which it is possible to lay bituminous macadam in some seasons will prove few indeed. There will be a somewhat longer period in which waterbound macadam can be placed, and a still longer period under the same weather conditions that concrete construction may be carried on. This is explained in that with concrete construction, after the roadbed is prepared, which will be done for the full length of the road or at least for a considerable distance, the subgrade is immediately covered with the gravel or stone to be used, and even tho it may become subsequently wet, it helps rather than retards the condition of the concrete. Whereas, a wet sub-base in macadam construction, either waterbound or bituminous, will prevent the use of a roller and delay seriously the progress of the work.

Like all other forms of road construction, if the concrete road is to give proper service, it must have proper maintenance. Just what it will be necessary to do to maintain properly a concrete road cannot now be entirely foreseen owing to the limited experience with this form of construction.

Most uneven places in concrete roads are started by the formation of a crack, the edges of which will become broken

down under traffic. That a crack forms shows that there has been movement of the concrete, and doubtless the cause resulting in the cracks still exists. If the cracks should become filled with incompressible material either by pouring in a thin grout or gradually filled with dust and grit from the road, there is every likelihood that the crack will extend under subsequent movement of the concrete slab.

It is believed that it is important to leave the concrete surface free to move as it shows by the appearance of cracks that it is necessary for it to do. Therefore, as soon as cracks are formed, and a sharp lookout should be kept for them, they should be cleaned out as thoroly as possible and filled immediately with some plastic material, such as an asphalt pitch. This will prevent water seeping through the cracks and also offers considerable protection to the edges, especially if the crevice is flushed with a slight excess of the pitch.

In the maintenance of concrete roads all expansión joints should be kept carefully under observation, and as soon as there is evidence that the plastic material has been worn away, as will happen during hot weather when it is squeezed out, it should be replaced and the cracks not allowed to become filled with hard material.

We have recently finished one good-sized contract at Clarinda, Iowa, using this machine, also two good-sized contracts at Cedar Rapids, for cement paving along with some curb and gutter work. The most advantageous feature of the new Koehring street machine is the 30-ft. boom with which we have our machine equipped, which allows us to lay sections without moving the machine and without skipping and going back. This is a great labor-saver and time-saver. The machine will mix when loaded to its capacity repeatedly almost to call it a continuous mixer. It takes 25 seconds for the boom to fill, swing out and come back to its place. It takes 15 seconds to load the machine from the elevator. There are many advantages that can only be arrived at by seeing this mahcine work. The mechanical arrangement and assembling of the machine is such that the working parts are practically perfect and are all protected and covered so as to keep the splash of concrete from getting into the cogs, etc.

California Highway Improvements

By Roy M. Horton, Engineer for San Joaquin County, California, Highway Commission.

In planning the proper road to be built in any location, the future cost of maintenance should be taken into consideration. If it happens that a source of good material is available, which can be obtained for maintenance at a low cost, it may sometimes be desirable to plan the roads so that the local material can be used. Where there is no cheap supply of material for maintenance, and where the traffic justifies building a road at all, it should be built with an idea of keeping the maintenance cost as low as possible.

In this country there are in general two locations where a good supply of local material is available and where, considering the fact that the county cannot raise the money at the present time to put in a pavement which will not need maintenance, the best course to pursue is to plan the roads so that the natural materials can be used in the future for maintenance. One of these locations is on the roads extending from Woodside to San Gregorio, and the other is on the road near Crystal Springs lake, west of San Mateo.

PERMANENT good roads dependent largely upon grade. Grades prepared so that they will be good for half a century.

The grading is the most permanent thing about a road, and before money is expended upon any type of surfacing for a road, the grade is prepared in a manner which will make it useful twenty-five or fifty years from now. It is a waste of money to place expensive surfacing materials upon a temporary grade. The grade is one of the most important considerations of the proposition, because the grade is there for all time and our successors should find the grades which we build in such condition that they will need to put no further expense upon them when they find it necessary to change or renew the surfacing of the roads. Therefore, no matter what type of pavement, expense is not spared on the grades.

On the roads which receive the heaviest traffic, those lying along the bay side of the county, the grades are constructed to a width of at least 30 feet, so that ample room for turn-outs may be afforded. On the mountain roads the width of grade can be safely made less than 30 feet, because of the lighter traffic and the lessened speed of vehicles. On the most important of the mountain roads, the grades are not less than 24 feet in width. Twenty or 22 feet are very satisfactory widths for grades and there is no danger when vehicles meet on grades of these widths.

In regard to the widths of the road, it has been demonstrated that a surfacing 15 feet in width, is, for all ordinary

traffic, just as serviceable as one which is 16 feet in width. Two automobiles or two ordinary horse-drawn vehicles can pass with just as much ease on a 15-foot pavement as they can on a 16. Only extraordinarily wide roads would experience difficulty in passing upon 15-foot pavement. Therefore a good many of the roads are planned to be 15 feet in width. A few are planned to be 14 feet in width. Fourteen feet is the narrowest width on which two ordinary vehicles can pass with ease.

ROAD widths between ten feet and fourteen are uneconomical.

The 12-foot road is not recommended because it is wider than is necessary for one vehicle, and not wide enough for two. If it were found necessary to cut the width of road less than 14 feet, it should be made 10 feet rather than 12. The road will cost less and be just as serviceable.

The estimates include connecting the state highway thru the different incorporated cities which it touches, and constructing the main county roads in four municipalities, the town of Burlingame having been omitted because that municipality has already let a contract for improving the portion of the county highway which lies within its corporate limits, and Daly City being omitted because the state highway commissioner will undoubtedly include the paving of the main street as a part of its contract on the mission road.

The estimated costs of improving the county road lying in the four municipalities referred to, included in the tabular summary of estimates for the proposed bond issue, are in detail as follows:

In Redwood City, length 9293 lineal feet. Pavement to be constructed to a width of 24 feet with gravel shoulders 7½ feet wide on each side. The pavement is estimated at 16 cents per square foot, including grading, and the total cost is estimated at $39,885.

In the city of Hillsboro, the length is 1,214 lineal feet. The pavement is to be constructed 24 feet wide at a cost of 16 cents per square foot and the gravel shoulders 7½ feet wide are to be built on each side. Total estimated cost, $4,662. The old macadam road on the present road can be used for shoulders in the city of Hillsboro.

In the city of San Mateo the length is 8,026 lineal feet. The pavement is to be constructed 24 feet wide at a cost of 16 cents per square foot, including grading, making a total of $30,820. The old macadam on the present road can be used for shoulders.

In South San Francisco, the length is 9,300 lineal feet. The road is planned to be 20 feet in width at 15 cents per square foot, not including grading. Gravel shoulders are to be constructed for the full width of the grade on each side. The cost of grading within the city limits is estimated at $10,480, making a total cost within the city limits of $43,180.

ESTIMATED COST OF PAVEMENTS FOR BOND ISSUE.

Road	Miles	Grading	Total
Bay Shore	5.12	$ 25,650	$ 106,746
Hillsboro-Halfmoon	11.54	32,240	85,625
Belmont to Lakes	6.0	14,000	52,080
Woodside Road	5.64	4,500	71,252
Woodside-W. Creek	9.00	45,000	84,424
W. Creek-San Gregorio	10.87	15,000	54,322
Menlo Park Road	3.28	5,000	37,310
Middlefield Road	3.40	4,000	42,238
Colma-Halfmoon	28.96	91,000	285,054
Halfmoon-Pescadero	21.37	57,700	132,224
Redwood	1.76		39,885
Hillsboro	0.23		4,662
San Mateo	1.52		30,820
South San Francisco	1.76	10,480	43,180
	110.45	$304,570	$1,069,822
Bridges and culverts			100,000
Rights of way			25,000
			$1,194,822
Plus 8 per cent			95,586
Total of estimate			$1,290,408
Recommended for bond issue.			$1,285,000

AVERAGE COST.

	Miles	Total cost	Cost per mile
Grading	110.45	$304,570	$ 2,757
Gravel roads	32.24	112,538	3,490
Macadam roads	25.04	77,389	3,090
Asphalt roads	53.17	575,325	10,820

MAJORITY of contractors have awakened to the value of up-to-date labor-saving equipment.

On account of the length of haul and the character of the roads the majority of the contractors now deliver the bulk of the materials in 7-ton Port Huron steel dump cars drawn by Port Huron road rollers. Many of these cars and road rollers are employed in this service. The rollers draw one, two or three dump cars, depending on the condition of the road over which they travel. The average train is three to five cars to the roller. It has been demonstrated that these trains are operated just as fast as a good team can walk under similar conditions. They are stated to work better than teams except where the road is muddy. The cost of hauling with the rollers and cars also has been found to be less than when teams were used.

Even patent dump wagons which do not spread evenly while dumping are now out of date for distributing material in the work of constructing macadam, gravel, etc., roads; and farm wagons with slat bottom boxes are greatly behind the times for doing such work. Compared with self-dumping, non-spreading dump wagons, Port Huron cars save in spread-alone 2 or 3 cents a cubic yard (depending upon the price of labor) as against hand raking, and 3 to 4 cents as against shoveling from platform. Compared with farm wagons with slat bottoms, these cars save from 2 to 5 cents a cubic yard (depending upon the price of labor) in dumping and spreading stone, etc., on the road bed.

Creosoted Wood Block Pavement in Longview, Texas

By P. E. Green, Assoc. M. Am. Soc. C. E., Consulting Civil and Sanitary Engineer, 17 N. La Salle St., Chicago.

Longview is a typical Southern city of east Texas. It has a population of 8,000 and is growing very rapidly. It has never had any considerable amount of public improvements until within the last year or two, when some macadam pavements were constructed outside of the business center of the town. These macadam pavements were constructed on entirely wrong principles, so that in less than a year they were in bad condition. In the spring of 1911 the city decided to pave the central business district of the town with a permanent pavement, and on August 11, 1911, received bids on approximately 17,000 square yards of brick and creosoted wood block pavement on 5-inch concrete base. The specifications called for No. 1 brick, to have a 2-inch sand cushion, and the joints to be filled with asphaltic cement, and the wood block to have a 1-inch sand cushion and the joints to be filled with sand.

The low bid for the brick was $2.35 per square yard, including a five-year guarantee; for the wood block the bid was $2.41 per square yard, under the same guarantee. The specifications for the brick called for a 20 per cent. abrasion test in the new standard rattler, as recommended by the Association for Standardizing Paving Specifications. The wood block specifications called for yellow pine timber, the blocks to be from 5 to 10 inches long, 3 inches in depth and 4 inches in width. The preservative specified was the best grade of coal tar creosote, having a specific gravity of from 1.03 to 1.07 and to contain not less than 25 per cent. of naphthalene and 25 per cent. anthracene.

The sand used for the bed for the blocks was a fine local sand, carrying considerable clay. It was well suited for the sand bed, since it would stand a very considerable washing, such as it would receive in a rainstorm. It was observed that after a heavy rain lasting twenty-four hours there was but little sign of washing of such sand as was exposed, and that during the entire time of the rain the water draining off from this sand bed ran clear.

Yellow pine having annular rings averaging not less than eight to the inch was specified for the paving blocks, and in no case were the annular rings to be less than six to the inch, measured radially. Such a specification called for a very good grade of lumber. Considerable difficulty was found, however, in maintaining this standard, as a great deal of the timber shipped by the manufacturer had four or less rings to the inch and was probably a poor quality of short-leaf pine. The six-to-the-inch standard was rigidly maintained, with the result that the amount of culls was 7 per cent., or nearly 1,100 square yards. These culls were afterwards used in paving an alley where the wear of traffic would not be so great.

Part of the wearing surface was laid during hot, dry weather, and this afforded

a very good opportunity for observing effects of expansion and bleeding. Expansion joints 2 inches wide were made at each curb line, the roadway being 70 feet in width; no transverse expansion joints were used. As has been stated previously, the filler for the pavement was sand, thoroly swept into the joints, and the expansion joints themselves were filled with asphaltic cement. As originally planned, the blocks were to be laid from gutter to gutter, at right angles to the roadway, but at the request of the contractor he was allowed to lay two longitudinal courses of blocks at the gutter line and divide the expansion joints between the two courses. When the work was half finished it was evident that this was a mistake. These longitudinal joints are not bonded or keyed to the rest of the pavement and have little power of resistance to transverse pressure. The asphaltic filler tends to get slightly under them, and the expansion taking place across the roadway forces the longitudinal blocks up. The asphalt would then be forced still farther under them, making it difficult to get the blocks into their original position. It was then decided to return to the original method of laying the blocks, and no further trouble was experienced from this source.

In the center of one of the streets was an antiquated horse-car line. On account of the financial condition of the company owning the line it was impossible to provide new rails, and the old rails consisted of a T-section of about 20-pound weight. The blocks were laid between the rails, and it was in this location that the only real trouble from expansion occurred. These blocks bulged along the entire line of the railway, and repeated repairs seemed to do no good. Between the rails there was no provision for expansion, as it was not thought possible that within the short width of the gage (4 feet 8½ inches) expansion would be noticed. It was finally decided, however, that the very light rails were deformed by the pressure from the outside, and this pressure, being thus transmitted to the blocks between the rails, caused them to rise up.

Two details of construction aided to bring this condition about, and this incident also serves to show how the best of plans sometimes fail because apparently minor details are overlooked. It was originally specified that a special street car brick be laid against the inside rails. On account of the lightness of the rail section it was not possible to get the special brick, and hence it was decided to lay the wood block directly against the rail. The rail was 3 inches high, and necessary depth to be allowed on the head for the wheel flange was ¾ inch. Hence the end block had to be chamfered on the bottom so that at its end it could have a depth of 2 inches, leaving ¼ inch depth for the mortar bed. A section across the pavement between the rails would then show a flat arch, the rise being ¾ inch. As has been stated, no appreciable expansion was expected. The end blocks might have been beveled on top instead of at the bottom, but the objection to this was that the fresh surface of the timber would be exposed to the weather and traffic. Later experience showed that this would have been better, for it was the arched section which developed weakness under the pressure from the outside blocks, as might have been expected.

An expansion joint was made down the center of the track by cutting individual blocks and filling them with asphaltic cement, and no further trouble was experienced from this source.

Recut Granite Block Streets in Schenectady, N. Y.

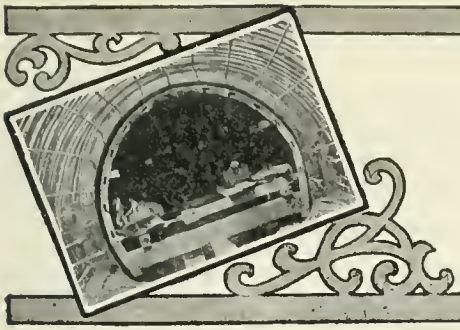
Sections of State street, in Schenectady, N. Y., have been paved for years with granite blocks of about 12 by 4 by 8 inches dimensions. The city is now relaying these streets, by taking up the blocks, cutting them into smaller sizes, about 6 by 4 by 4 inches, and re-dressing them and laying the smaller blocks. Where the old foundation was not of concrete a 4-inch concrete foundation is put in and the blocks are set in the wet concrete, the joints are filled with cement grout and the surface is flushed with the same. The work is done by city labor and with the concrete foundation is costing about $1.50 a square yard. It is evident that the granite blocks when thus cut into the smaller sizes will lay double the area of pavement, and when the surplus from one street is laid to replace a wearing surface on another street, the concrete foundation being already in place, the cost is about $1 a square yard.

Charles A. Mullen is the superintendent of public works who is thus doubling the city's granite block surfaces.

Slag for Concrete Curb and Gutter

By Chas. L. Marsh, City Engineer, Gadsden, Ala.

I have used a basic slag for concrete curb and gutter for five years. I can find no fault with it. No sign of any stain or disintegration on any of it. I use this slag in all arch work up to 15 feet in diameter. It has proven good, and is about one-half as costly as stone.



SANITATION

Institutional Disposal Plant of Infirmary and Children's Home of Greene County, Ohio.

By A. Elliott Kimberly, Consulting Engineer, Columbus, O.

In my opinion sewage purification plants for State and County institutions are of unusual interest.

The plants for the Infirmary and for the Childrens Home of Greene County, near Xenia, O., serve 100 and 75 persons respectively.

Since filters constructed of fine grain material for sewage are more effective than other primary filtration procedures in removing organic matters, and since their operation is simple, such plants appear best adapted to the sewage treatment needs of the smaller institution. Moreover, the cost of filtering material, while relatively high in regions where the glacial drift formation is absent, does not usually prevent the use of filters of fine grain because of cost as might be true for large institutions or for small municipal plants.

In view of the above considerations, intermittent filters of fine grain material were alone considered for these Greene County plants. In broad terms, the plans provide for the interception by a screen of the coarser matters present to an unusual extent in institutional sewage, removal by sedimentation of a part of the suspended matter and oxidation of the dissolved impurities by intermittent sand filters to which the sewage is applied intermittently, automatically and in considerable volume.

The screened sewage enters a covered reinforced concrete settling tank 4 feet by 10 feet in plan, with a flow-line depth of 6 feet. The capacity of the tank is about 1,800 gallons, which affords a period of retention of 11 hours at the maximum capacity of the plant. A manhole is provided for entrance to the tank. Sewage enters the tank thru a cast iron elbow extending to a point 2 feet 6 inches below the flow line, and flows out over a weir plate 6 inches in length and placed on the center line. Cypress baffle boards are located 3 feet from the inlet and 9 inches from the outlet end, and extend 3 feet 9 inches below the flow line.

FILTRATION *bed, Xenia, Ohio, which receives the discharge from the settling tank through a Miller alternating five-inch siphon.*

Contiguous to the settling tank is a covered dosing tank 7 feet 9 inches square in plan. It is constructed of reinforced concrete. A manhole is placed in the roof to give access to the siphons. The tank is operated by 5-inch alternating siphons, of the Miller type, set to

draw 4 feet. With no allowance for inflow, the discharging capacity of the dosing tank is about 1,800 gallons. Independent discharge lines of 6-inch vitrified sewer pipe conduct the sewage to an influent chamber whence it is applied to the sand filters.

The sand filters are each 38 feet square in plan. The surface area is 1,444 square feet or 0.033 acre each. They are separated by a concrete wall, the other three sides of each unit being formed by embankments sloping 1½ to 1. The filters contain 3 feet 6 inches of sand supported by a graded gravel layer of 6 inches maximum thickness. The effective size of the sand actually placed in the filters is 0.23 m.m.; the uniformity coefficient 1.8. Each filter is drained by two lines of 4-inch vitrified sewer pipe leading into a main drain 6 inches in diameter. The lateral drains are laid with open joints and with an open space of about ½ inch between the lengths of pipe. The bottom of the excavation is sloped to each drain and equal areas are tributary to each lateral drain.

The necessary feature of intermittent operation of sewage sand filters is, of course, well understood. This feature is usually obtained by providing a dosing tank with automatically operated siphons. These devices insure the application of a volume of sewage sufficient to cover practically the entire area of the sand surface. In the writer's experience, the direct flooding of sand filters at institutions (dosing tank omitted) is not advised because the rate of flow varies within wide limits and at night practically ceases. The directly flooded filter remains in service a given number of hours after which the sewage is diverted to another filter. This feature entails or should entail more or less continual and intelligent supervision, a departure from the original premise regarding simplicity and ease of operation.

The sand filter is the most successful of all types of plant for the small institution where there is desired a well-putrified, stable effluent. In fact, such filters can be considered to advantage even for institutions of from 1,000 to 2,000 population. Of course, the question of cost will largely control for the larger places, where the problem really approximates that of the small municipality. Whether the choice be contact filters alone or in combination with sand filters or possibly sprinkling filters, simplicity should be the keynote of the design.

All automatic apparatus for these installations was furnished by the Pacific Flush Tank Company.

Facts About Collection of Garbage and Refuse

The average weight of garbage in cities is 1,150 to 1,475 pounds per cubic yard. The average weight of mixed rubbish and ashes is 800 to 1,100 pounds per cubic yard. In summer ashes form one-third the mixture and in winter three-fourths. The actual weights vary in different cities and in different districts in the same city, according to fuel used, whether rubbish is burned in stoves, habits and wealth of citizens, etc., so that a city must be divided into districts for collection purposes according to these variations as determined by a careful study.

A garbage collector requires an average of 3 minutes to remove the garbage from a house, half this time being consumed in getting into and out of the houses, so that a back-gate collection will require much less time. He travels 2¾ to 3 miles an hour and visits 40 to 90 places in an eight-hour day.

Collection by teams is the cheaper but hauling the full load to disposal plant by motor is the cheaper.

The garbage produced per capita averages from 175 to 225 pounds per annum, rubbish and ashes 325 to 530 pounds. Street sweepings amount to about 1/3 cubic yard per capita.

Mixed collection of all garbage and refuse costs less than separate collection. The mixture of all refuse is cleaner to handle, prevents fly breeding and lessens dust from ashes. The can for separate garbage collection is liable to become a greater nuisance than frequently collected garbage.

Free Garbage and Refuse Collection in Schenectady, N. Y.

The city of Schenectady, N. Y., began, about September 15, the free collection of garbage and refuse. The ordinance requires every householder to procure a standard garbage pail and ash can, and the city has made arrangements to supply these cans at the lowest possible cost. The decision last summer that the city could not engage in the ice business prevents the supply of the cans by the city directly, and an arrangement has been made by Commissioner C. A. Mullen with a large department store, H. S. Barney Company, to supply the cans at the same low prices, made possible by the size of the order. That the prices are low is shown by the list: Garbage pail and cover, 7-gallon, 50 cents; 10-gallon, 60 cents; 12-gallon, 70 cents; ash can and cover, 16-gallon, $1.60; 24-gallon, $2; 32-gallon, $2.40, delivered.

FIRE AND WATER

Maintenance of Fire Department Grounds

By W. E. Bideker, Chief Fire Department, Fort Worth, Tex.

The last three years have witnessed the development in Fort Worth of a remarkable phase of civic beautification—the transformation each summer of the grounds surrounding the fire halls into garden spots planted with a variety of shrubs and flowers.

Beds of white and red coleus or verbenas and pink and white coleus laid out carefully in many shapes and sizes, dozens of rose bushes planted symmetrically about the lawns or along the sides of the station buildings, together with trellises of honeysuckles and hedges of castor beans have combined to effect a complete and wonderful transformation.

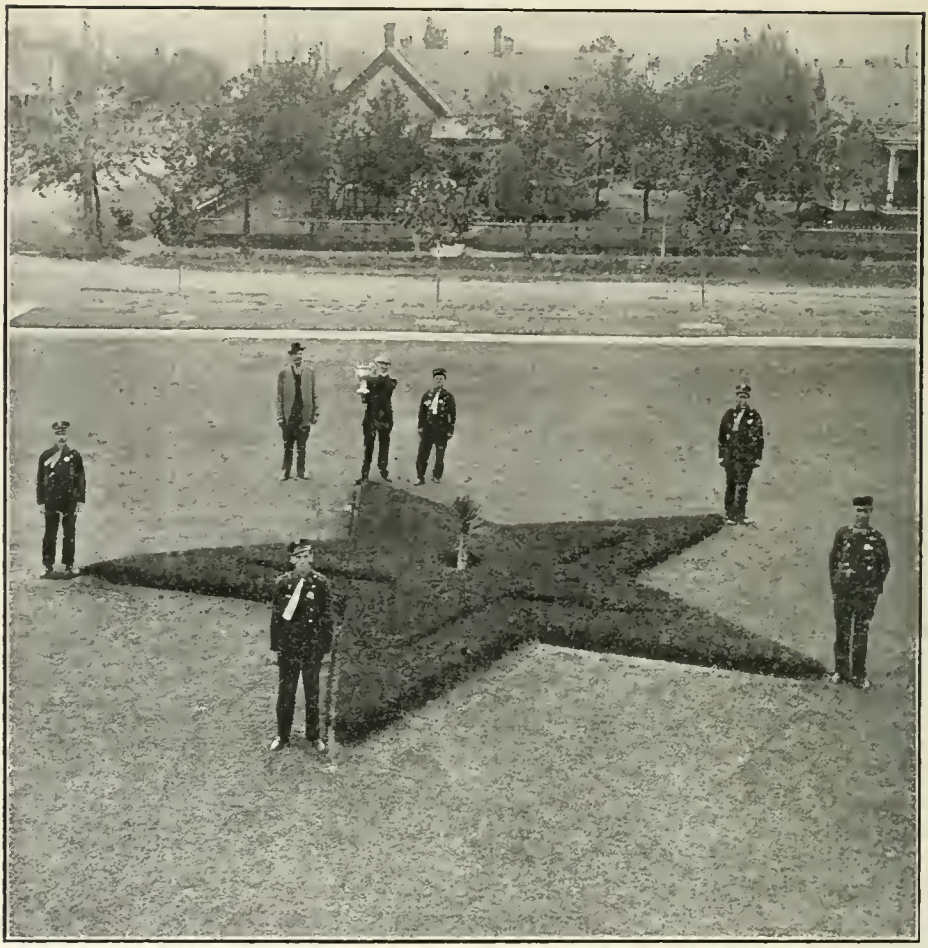
In several instances that have come to my attention, the improved appearance of the fire hall grounds has proved a potent example to nearby residents. Emulating the firemen, these citizens have trimmed their own ragged lawns, planted rose bushes and a few flowers and have trained vines over their front verandas. Some of them have even given their houses a coat of fresh paint.

The movement has resulted in the appearance each summer in the windows of the fire halls and the homes in their vicinity, of green-painted "garden boxes." Thruout the summer these miniature gardens planted with Wandering Jew, the dew plant and asparagas sprengari, have been things of beauty, their trailing vines set off to excellent advantage against the stone and brick of the buildings. Intense rivalry, increasing year by year, has marked the efforts of the firemen-gardeners.

The movement for the beautification of fire hall grounds had its inception in the spring of 1910, when a local paper launched its first flower garden contest.

Considerable preparation was made for the contest. Assistant Chief Ferguson, an enthusiastic and expert amateur gardener, was called upon to furnish designs for

NUMBER 10 *fire station, Ft. Worth, Tex., showing the possibilities of beautification of stations.*



WEST LAWN *fire station No.* 13, *which won the Costan cup for two consecutive years*, 1911 *and* 1912.

beds; Lieut. John Black, of Station No. 7, now captain of Station No. 13, superintended the work of his men, with the result that the coveted cup went to No. 7.

The experience gained by the contestants proved exceedingly valuable to those who essayed to win the cup the ensuing two seasons. It was found that the red and white coleus planted in neatly arranged beds made an exceedingly pretty picture, when set off by the green of the clustering alternatheras used as a border plant.

The second year of the contest witnessed several additions to the list: No. 13 fire station, Hattie and Buxton streets, commanded by Captain Black, promoted from No. 7, came into the limelight with a bound. In spite of the handicap which the men were forced to overcome in the way of extra work necessary to get their grounds into shape, they won the Costan cup handily.

Station No. 12, Prospect between Twenty-fourth and Twenty-fifth streets, on the north side, and Station No. 8, Lipscomb and Bellevue, also became contestants. Well arranged beds were laid out, breaking the monotony of lawns which had formerly been maintained about their buildings.

The announcement of the 1912 contest witnessed the active participation of every one of the thirteen fire halls in the city, with the exception of No. 1, Second and Commerce, and No. 11, Twelfth and North Main streets, on the north side. Surrounded by cement sidewalks, laid close to the building, affording no space for planting flowers or a lawn, No. 1 was debarred from entering the contest, except by means of window boxes. Its men

made the most of their opportunities last spring, however, and succeeded in producing some "handkerchief gardens" that were the admiration of the judges in the floral contest.

Firemen at No. 11 station have been unable to secure any results in their attempts to grow flowers owing to the gravelly nature of the soil in their vicinity. They too, planted several pretty window boxes.

Under the direction of Captain Black, the men at No. 13 laid out a vinca bed in front between the sidewalk and the curbing and planted rose bushes at the sides of the building and between the driveways. On the west lawn there was a star-shaped bed of green and red flowers, with a border of alternantheras. Other smaller beds were laid out and a trellis work of honeysuckle placed at the back of the building to the east and north.

Such careful and artistic effort did the firemen here display in preparing their grounds that they won the Costan cup for the second time.

Floral displays at the various stations resulting from the contest, elicited many favorable comments from visitors during the summer months. A delegation from the National Association of Fire Engineers which passed through on their way to the Denver convention, were especially impressed and complimented Chief Bideker highly.

Water Meters as Handled by the Water Meter Department

By Otto F. Poetsch, Superintendent of Meters.

Water meters in the city of Milwaukee are furnished at the expense of the consumer. All services are required to be metered. The total number of meters set up to January 1, 1913, is as follows:

All the public buildings, fire houses, patrol stations, natatoriums, etc., as well as the large public parks, were metered during 1912, all work having been done by the meter department. As a result, the water department will be able to ascertain the actual amount of water consumed at these places in the future.

The following is a summary of the work done in 1912, compared with 1911, which shows the increase of work to be 24 per cent. over that in 1911:

	1911	1912	Increase
Meters in service	55,291	57,657	2,366
New meters tested	2,719	2,768	49
New meters set	2,320	2,383	63
Large meters retested on premises	160	176	16
Meters examined and repaired in shop	6,650	8,950	2,300
Meters examined and repaired on premises	5,128	6,260	1,132
Meters requiring new repair parts	2,739	4,846	2,107
Total amount of meters handled	14,657	18,154	3,497

The inauguration of a systematic manner of testing of meters in service by the meter department and the repairing and readjustment of same to secure an accurate registration, is one of the important features of a survey or investigation of water service of the city and will greatly assist in future work of this division.

The work of putting in the service and making connections for meters is done by licensed plumbers, the city inserting the tap and the plumber continuing with the work after the tap has been made. When ready to have a meter installed, he delivers the meter to this department and makes written application, on Form No. 1, supplied by the department.

SIZE.	Worthington	Niagara	Badger	Neptune	Keystone	Thomson	Worthington Disc	Hersey	Nash	Union	King	Worthington Turb	Neptune Crest.	Standard Disc.	Westinghouse.	Crown	Nilo	Hersey Torrent	Fajas	Gem.	Eureka	Hersey Detector	Standard Current.	Trident Comp.	Empire	TOTAL
⅝ inch	13163	13203	8772	3392	3415	3223	1989	2363	1898	57	8			38	27	16			3						1	51,568
¾ inch	966	555	1255	219	247	154	357	111	123	39	5				4	4										4,039
1 inch	362	78	70	72	25	50	68	22	31	40	16					4										838
1¼ inch		4	9		1		18																			32
1½ inch	172	33	20	28	8	8	35	2	3	29	6	1				1					1		1			348
2 inch	148	58	61	18	6	9	57	3	1	18	17	5	3													404
3 inch	134		28	9	7	9	17	3	1	12		16	8				8	1		2	1			1		257
4 inch	35		19	6	6	1	4	2		9	1	20	21			2	3	1		1				1		132
6 inch	4				1	1				3		5	6			3		2			1	1	1			28
8 inch													1					2			2					5
10 inch													4													4
12 inch												2														2
Totals	14984	13931	10234	3744	3716	3455	2545	2506	2057	207	53	49	43	38	31	30	11	6	3	3	3	3	2	2	1	57,657

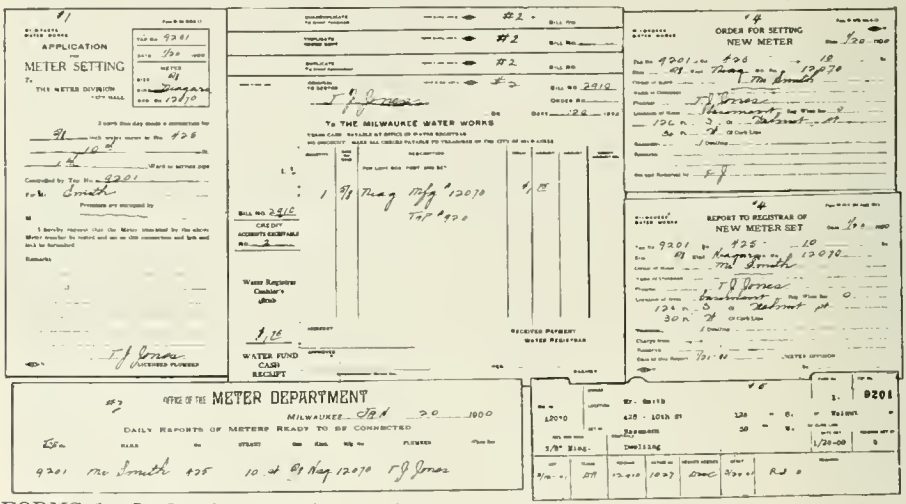
CHART *showing different kinds of meters and sizes in use.*

Upon receiving this application, which shows the tap number, owner's name and location, size and kind of meter, a bill for the testing and setting, which is done by this department, is made in quadruplicate form, which is payable in the office of the water registrar.

After the charges for testing and setting have been paid, the meter is listed on sheet No. 3, ready for setting. From this list setting orders are made out on Form No. 4. This is made in duplicate form, the original remaining in the office and the duplicate going to the shop foreman, who checks out the meter and has it set by the meter setter. The meter setter sets the meter and makes out report of the location and what the meter controls on the duplicate setting order. The duplicate is then returned to the office and the original filled out. The original then goes to the water registrar, as a report of new meters set, in order that an account can be opened and the meter thenceforth read monthly. A meter record card, Form No. 5, is also made out at the same time and becomes a permanent record of the meter at all times. This card, as will be seen, gives full data for the meter; also space is provided for any further transactions, so that the card at all times shows the complete history of the meter from the date it was first installed to the present day. This card is filed according to tap number in a special filing case. With the use of the guide cards any record card can be had in a few seconds. Cross reference index of manufacturer's number to tap number is also made and filed according to manufacturer's number, showing the size and kind of meter and tap number so that the record of any meter can be readily found, should one turn up with only the factory number on it. The forms Nos. 1 to 5 are shown in the group in the first of the accompanying cuts.

A house number index, from which the tap number can be readily gotten, is also maintained by the water registrar, to which this department has easy access, thus making it possible to locate any meter by either the tap number, manufacturer's number, house number or lot and block number.

After the meters are installed they are read monthly by the meter readers. If, while taking their monthly readings, a meter is discovered out of order, same is reported by them. A field order, Form No. 6, is made out. All leaks and dirty dials reported on field orders are repaired on premises. These meters reported as not registering or where the consumption is questioned are ordered off and brought back to the shop. When a meter is brought into the shop a "Meter Take-Off and Resetting Order" is made out, Form No. 7. This is made out in duplicate form. These orders are put in an assembling tray and taken out when routed on route list, Form No. 8. This list is given the meter men, who take off these meters and bring them into the shop, reporting the reading for same. This list is then returned to the office in order that the "Meter Take-Off and Resetting Order" can be properly filled out. The original is then sent to the water registrar in order that he may make proper entry on his meter card. A duplicate is sent to the shop and goes on the meter and remains with the me-


APPLICATION
METER SETTING
ORDER FOR SETTING NEW METER
REPORT TO REGISTRAR OF NEW METER SET
To THE MILWAUKEE WATER WORKS
METER DEPARTMENT
DAILY REPORTS OF METERS READY TO BE CONNECTED

FORMS 1—5, *showing records used from the time the application is made until the meter is set.*

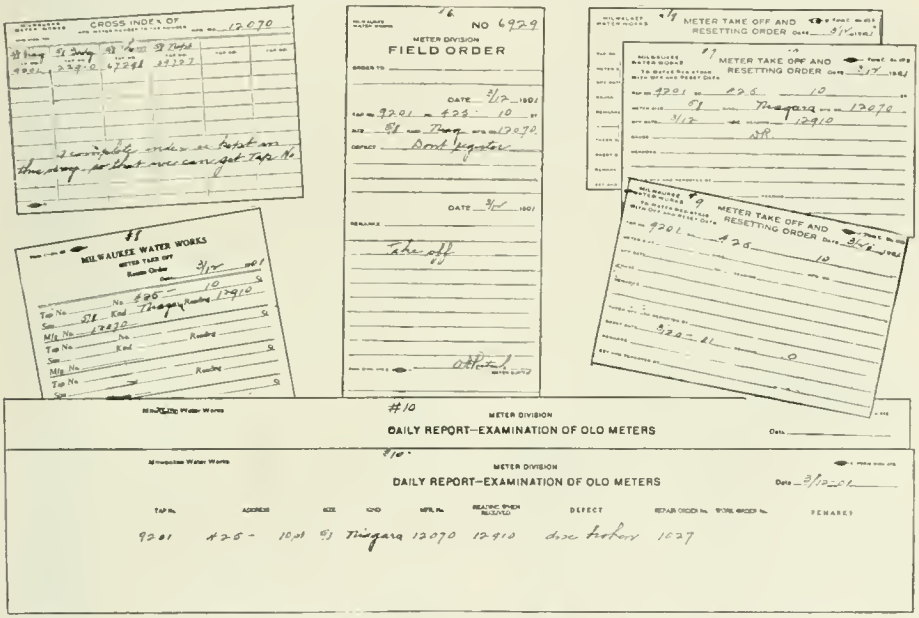
ter until it is reset. The off record is also noted on the meter record card, Form No. 5, so that a record of same is had in this office.

After the meter has been repaired and reset the duplicate "Take-Off and Resetting Order," Form No. 7, is returned to the office, entered on the meter record card, Form No 5, and reported to the water registrar on Form No. 9. During the time that this meter is off a connection pipe is inserted and the water averaged for the period that the meter is off.

Every meter as it comes into the shop is listed by the stock clerk on Form No. 10. The cross index blank and Forms 6 to 10 are shown in the second cut.

If the meter requires any repairs a work order is made out by the stock clerk in triplicate form, the first being used as office copy and for non-chargeable work. See Fig. 11. The pink order or second copy goes directly to the cost clerk in the accounting department. The triplicate, which is printed on a card, is sent with the notice, Form No. 12, to the owner or occupant for signature. Upon being returned this order is sent to the shop foreman, who has this meter repaired upon this signed order. The order also acts as an order to get repair parts from the stock clerk, who enters same on the order and also checks out of the stock the parts delivered on this order. Forms 11 and 12 are shown in the third cut.

A daily report of all parts leaving the stock room is made out on Form No. 13, which shows on what work order or repair order each item was used. This sheet goes to the cost clerk daily, in order that it can be transcribed or posted on his copy of the repair order. The cost clerk also gets the time sheet of each man, in order that he can post the time spent on each job to its respective order. In this manner the cost clerk in the accounting department posts the repair parts used and the time spent in repairing on any particular order. When a job is completed a bill for same is made out. The cost clerk also keeps a card record stock account of all meter parts, materials and supplies. These are checked out on his cards by him, as the stock leaves the stock room. All new stock purchases are reported on Form No. 15, which goes to the cost clerk, in order that same can be entered on the stock records. At the end of each year an inventory of stock according to stock cards is taken, which must agree with the physical inventory of parts in the stock room. Forms 13, 14 and 15 are shown in the fourth cut.



FORMS 6—10, *cross index of manufacturer's number to tap number, field order, meter take-off and reset order, and daily report on old meters.*

Practical demonstration made on auto trucks and a tabulated record of work done by horse teams convinced us that it would be beneficial to replace horse teams with auto trucks.

The following tabulation shows the work done by four teams for five and one-half days. It shows the number of jobs attended to, the actual time used in team-

ing to the jobs and return and the actual working time spent in taking off or setting meters.

ONE WEEK'S WORK WITH FOUR TEA..S.

	Job	Team time hr.	min.	Work time hr.	min.
Setting new meters	117	20	39	23	5
Taking off old meters	124	19	21	22	50
Taking off old meters	145	16	46	25	16
Resetting old meters	157	18	6	28	53
Total	543	74	52	100	4

These figures were taken at the time when we were very busy and had a good many meters to take off for repairs and to set, thereby making it possible to route the work very close.

It can be said to show the maximum work that can be done by a horse team under the best conditions, as figures show an average daily setting of 24½ meters per team. Ordinarily when work is normal the average would not be more than 10 to 20 per day.

It will be seen that 42 per cent. of the time was spent in driving the teams to the jobs and back to the shop; 57 per cent. of the time was left to work in.

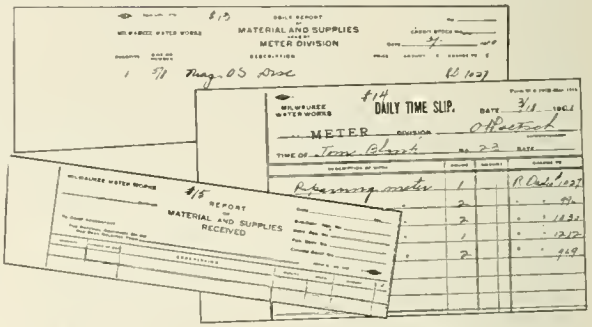
When one realizes that 42 per cent. was spent in teaming under the best condition, one can see that a good percentage of teaming time can be cut down by using a motor truck, thereby increasing the actual working hours considerably, which will result in higher daily average of meters set.

In our case we found that a truck can set or take off thirty-six meters per day.

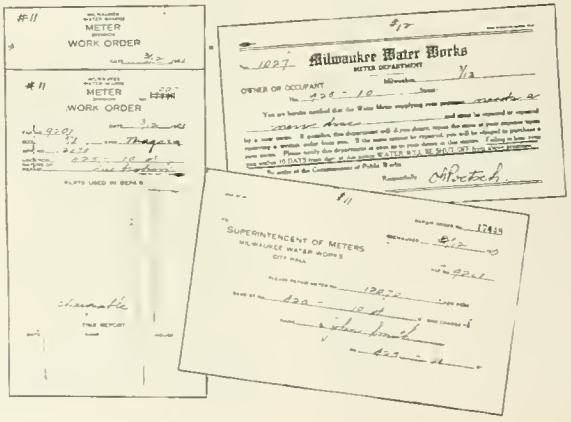
There is another feature in favor of trucks of great importance. The work can be kept up to the handle at all times.

In using teams, we had the city divided into ten districts, while by using two trucks we were able to cut the city into four districts. The work does not have to wait until it can be closely routed, as was the case when using horses, as the trucks cover a far greater territory.

During the year 1912 we purchased a shaper, pipe-cutting machine, drill press, and wet tool grinder, all equipped with motor drive. These machines, in addition to those that were previously installed, make our machine shop complete. In general, it enables us to do more and better work at less cost to the city, as well as to do more and better work to the consumer. The new shaper has been of great assistance, and work can be turned out on this machine in fifteen to twenty minutes that it formerly took a man several hours to do by hand. Not only does this machine save time, but better work can be turned out. The same is true of the new drill press. The work can be done in less time and more accurately.



FORMS 13—15, *used for recording materials used, time slip, and materials received.*



FORMS 11—12, *repair records.*

Robinson Fire Engine Test

By David M. Hudson, Chief of Fire Department, City of Chelsea, Mass.

Chelsea, Mass., a few months ago tested its newly purchased Robinson piston pump motor fire engine, under the direction of George W. Booth, chief engineer of the National Board of Fire Underwriters. After the incident Engineer Booth addressed a letter to the writer. Following is a complete copy of the letter:

The National Board of Fire Underwriters
135 *William Street.*
New York, May 26, 1913.

David M. Hudson, Chief of Fire Dept.,
Chelsea, Mass.

Dear Sir—Following is a statement of the results of the tests of the Robinson "Monarch" automobile pumping engine recently delivered to your department, made at Chelsea on the 24th inst.:

The first test was made at draft, with a suction lift of 10½ feet, pumping water from an arm of Chelsea creek, thru one line of 100 feet and one line of 50 feet of 2½-inch hose, siamesed into a deluge set with a 2-inch nozzle (actual diameter 2.01 inches). The average discharge pressure during the test was 119½ pounds and the suction lift corresponded to 7½ pounds, giving a net pump pressure of 127 pounds. The average nozzle pressure was 60.8 pounds, corresponding to a discharge of 937 gallons per minute against a net pressure of 127 pounds. The test continued for a period of 45 minutes (except for a delay of 4 minutes to replace a length of burst hose), when it was discontinued in order to make the tests arranged for near the city hall. During the 45-minute test the engine appeared to be running easily, with plenty of reserve power. The tests at city hall were made for short periods, taking suction from a hydrant. Most of them used four 250-foot lengths of 2½-inch hose siamesed into a deluge set of nozzles of different sizes as follows:

With 1½-inch nozzle, discharge pressure 190 pounds, suction pressure 57 pounds, net pump pressure 133 pounds, nozzle pressure 143 pounds, discharge 798 gallons per minute.

With 1⅝-inch nozzle, discharge pressure 170 pounds, suction pressure 50 pounds, net pump pressure 120 pounds, nozzle pressure 124 pounds, discharge 872 gallons per minute.

With 2-inch nozzle, discharge pressure 145 pounds, suction pressure 30 pounds, net pump pressure 115 pounds, nozzle pressure 74 pounds, discharge 1,023 gallons per minute.

Other tests were made with three or four lines of hose, each leading to 1-inch or 1¼-inch nozzle, but I do not feel sure enough of the size of these nozzles nor the nozzle pressures to warrant a statement as to discharge and pressures.

Yours very truly,

(Signed) Geo. W. Booth,
Chief Engineer.

Auto Fire Engine Test

Fire Chief John McFadden, City of Memphis, Tenn., reports that on recent test of auto fire engine, the auto pumps developed a pressure of 220 pounds at the engine and delivered 570 gallons per minute at the nozzle. One stream ⅞ of an inch in diameter was thrown 175 feet in the air at the end of a 250-foot hose, while two streams were thrown 150 feet in the air. The water was pumped from a cistern, without the aid of the pressure from the city mains, and a leaky valve further handicapped the test; however, Chief McFadden was well pleased with the result.

The addition of an automobile engine for suburban service has greatly increased the general efficiency of the department, which is already rated as one of the best in the country. It is estimated that the upkeep of the auto engine is approximately 15 cents a day.

There were 56 fires in Memphis during October, 1913, according to department reports, which resulted in a total estimated damage of only $4,045. This is regarded as truly remarkable and reflects more eloquently than anything else can the efficiency of the department. Fifty of the blazes were confined to the rooms in which they originated. Three were confined to the building in which they originated, and the remaining three to property immediately adjoining.

Tiny electric bulbs, supplied with light from a small storage battery, now make it possible for engineers to read the gages on the darkest nights. As a result the practice of carrying lanterns for this purpose has been discontinued. The little incandescents are located immediately over the gages and the batteries are placed at out-of-the-way places on the engines.

Lighting

Philadelphia Specifications for Alley and Suburban Lighting

For 1913 the city of Philadelphia has a contract with the Welsbach Street Lighting Company of America, for about 20,000 60-candle-power gasoline lamps for lighting alleys and country roads at the rate of $29 per lamp per year.

For 1914 it is proposed to open the bidding to all kinds of light, bids to be received on candle-power specifications made by the bidders themselves. Advertisement was made calling for the receipt of bids on September 4, but there were no bidders. It is probable that bids will be called for again within a short time.

The special points of interest in the specifications are the following:

The contractor will be required to furnish lamps and the lighting and necessary maintenance thereof, and to light, extinguish and clean the same, such light to be used for the illumination of the streets, avenues, boulevards, sidewalks, alleys, wharves, bridges, parks and other public places in the city of Philadelphia; also to furnish and erect new posts and to properly maintain all property which comes within the scope of this contract.

The lamps shall be lighted in accordance with the time table made a part of the specifications, the lamp lighters not to climb the lamp posts except by ladder leaning against the pole.

The number and location of lamps will be determined by the director and may be changed from time to time.

Lamps will be tested photometrically to determine their actual street illuminating power. The lamps shall be of such kind and shall be so maintained that the complete lamp including accessories will give a light of not less than the candlepower stated in the proposal at an angle of 15 degrees below the horizontal, as determined by the tests specified. The light which is furnished on the average as determined by tests on not less than one per cent. of all the lamps each month shall be of not less than the above specified candlepower. The term "candlepower" wherever used in these specifications shall be interpreted as the intensity of the light expressed in terms of the International Candle as maintained by the National Bureau of Standards.

CITY reserves right to make candle-power tests and also specifies by what means they shall be made.

The city shall have the right at any time to test the quality and illuminating power of the lamps as furnished on the street and for that purpose one per cent. or more of the lamps may be selected from those in actual use in each district in each and every calendar month and their illuminating power shall be determined by measurements made as nearly as practicable at the angle of 15 degrees below the horizontal. The measurements shall be made on the lamps as complete units as operated on the street, and shall be made with the lamps in their regular position, by means of a Sharp-Miller portable photometer using a detached test plate and a mirror so mounted as to throw upon the test plate light emitted from the lamp at an angle of approximately 15 degrees below the horizontal. The average results of measurements made on any two opposite sides of a lamp shall be considered the mean candlepower of that lamp, provided that no measurements shall be made in a direction such that the frame of a lamp or a rod carrying a chimney or any similar accessory comes between the source of light and the test plate. The average candlepower of the lamps tested in one month in any district shall be considered as representing the light furnished by all the lamps in that district for that month.

No allowance will be made for light absorbed or obstructed by glass housings or accessories, since the candlepower stated in these specifications is intended to represent the average amount of light actual-

ly delivered on the street, and the object of the tests is to determine whether that amount of light is actually delivered.

The testing shall be made by two men, one representing the city and paid by it, and the other representing the contractor and paid by him. The report of measurements made by these two men shall be made in duplicate and signed by both men, one copy being supplied to the city and the other to the contractor. In case the contractor, after receiving due notice, shall fail to provide a man for the testing, the city may provide a second man and may deduct the expense thereby incurred from any amount otherwise due to the contractor.

The lamps in each district shall be numbered and listed consecutively, and the lamps selected each night for measurement shall be designated by their numbers. In the selection of lamps to be tested, which shall be by lot, the contractor's representative shall have an equal voice with the city's representative, but any disagreement or dispute shall be settled finally by the director.

If any dispute arises as to the methods of testing, apparatus used, or the results obtained, between the two inspectors, or between the city and the contractor, such dispute shall be referred to the National Bureau of Standards for settlement. The cost of such reference shall be paid equally by the city and the contractor.

No lamp showing less than 15 candlepower upon photometric test as described above will be included in the report made to the city and the contractor. The outside of the outer glass globe or housing of the lamp may be rubbed over before the test with a clean dry cloth.

DEDUCTIONS shall be made from contract price for failure to supply average candle power.

If the average candlepower of the lamps tested in any month falls below the minimum average candlepower stated by the bidder, then the contractor shall receive as full payment for that month the proportion of the total amount otherwise due him that the average candlepower obtained in the tests bears to the average candlepower so stated.

The contractor operating and maintaining the lamps tested shall replace lamps on the street not to exceed seventy-five (75) in each district in any one month whenever the director may request such replacement, free of cost to the city, and shall always keep in stock ready for operation at least seventy-five (75) lamps for each district.

The contractor will be required to furnish a patrol system which will be adequate to care for all lamps extinguished during the night. And in order to free the contractor from the expense of maintaining headquarters for such patrol system the city will provide six stations at various points over the city where said patrol may have space for desk, tools and necessary appliances for emergency repairs to the lamps.

All of the lamps are to be kept in a cleanly condition and all parts of the lamps shall be cleaned at least once a week; all the glass of the lanterns shall be thoroughly cleaned, both on the inside and on the outside, and all dust and dirt shall be brushed from the frames.

Any lamp which does not furnish illumination the full time required by the time table or which fails to deliver at least fifty (50) per cent. of the average minimum candlepower required by these specifications will be considered as "out" and the specified liquidated damages therefor will be collected under the conditions specified in a subsequent paragraph. Any lamp reported twice within 36 hours as an "out" shall be replaced by another lamp or by that part of same which constitutes the source of light at the option of the said director.

NEW lamp posts to be installed shall be according to designs and specifications meeting approval of directors.

New lamp posts, of a design satisfactory to the director, blueprints of said designs, giving dimensions and weights, to be submitted with the bid, are to be erected and fitted up on any street, avenue, boulevard, park, alley, wharf or public place wherever the same may be required by him, and are to be placed in a strictly perpendicular position. The butt of the lamp post shall rest on a solid foundation to prevent the same from settling, and the earth shall be thoroughly tamped about the butt, as the same is thrown into the excavation. These posts will become the property of the city as soon as erected.

All posts now in use are owned by the city, and the contractor shall have the use of them during the term of his contract.

If a new contractor shall have a contract for any or all of the lamps included in this contract at its termination the present contractor shall, at the direction of the director, remove such of his property and at such times as the director may order, so that the new contractor may have all of his plant in complete working order by the first day of his contract. The new contractor will receive no compensation for the lights which he may install and operate before the expiration of the present contract in place of lights included

in this present contract, and the old contractor shall receive full compensation for all such lights.

In case any lamp should fail to furnish illumination continuously the contractor will pay the city a sum of money equal to four times the charge to the city for one night's illumination for each lamp, for each and every night or part thereof that such failure shall continue. Provided,; that no lamp shall be considered an "out" until it has twice been reported out in a space of thirty-six (36) hours with an interval of at least three hours between the reports. The first and second reports of such a lamp out are to be made simultaneously to both the company and to the city. This double report is made to insure opportunity to the contractor to relight the lamp which is out and supply the city with the necessary light.

The bidder is to state the candlepower which he can most advantageously furnish, which must not be less than forty-five (45) nor more than sixty (60) candles, measured in a direction of 15 degrees below the horizontal. (A lamp of higher candlepower than 60 will be considered 60.)

CHARACTERISTICS of lamps and accessories which must be set forth in the contractor's bid.

Each bidder must supply with his bid a full statement of the characteristics of the lamp and accessories on which he is to bid including a statement of the iluminating medium to be used. These full characteristics are to include the following:

Distribution curves of the lamp as a complete unit (including reflectors, globes, etc., if any are to be used), and life curve showing how the candlepower in a horizontal direction, or at 15 degrees below the horizontal, decreases with the time of burning.

Complete working drawings of the lamp and all accessories including individual drawings of each part and one drawing of the lamp as a complete unit. Dimensions and weights to be stated on these drawings. Where protection to any patent right would interfere with complete working drawings being furnished, bidders upon so certifying may furnish assembled drawings in lieu thereof.

Statement of operation and performance of the lamps and such records of tests and performance as will be useful in judging the merits of the lamps.

The contractor for 1914 agrees that in case he is not successful in obtaining the contract for 1915 he will continue lighting his lamps after the close of his contract until the new contractor can install his own equipment, which installation must be completed by February 15, 1915. The contractor for 1915 will pay the present contractor for all service which he, the present contractor, supplies subsequent to January 1, 1915, the amount per lamp per night which the latter receives, unless the amount received by the new contractor for 1915 shall be less than is paid for 1914, in which case the price to be paid will be that fixed by the new contract.

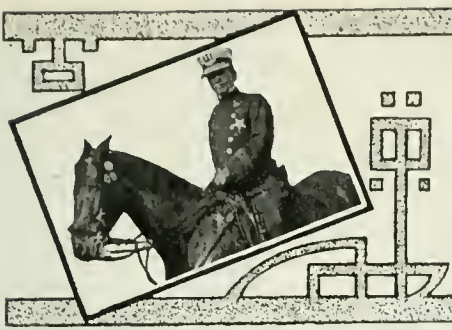
The time schedule provides for 3,955 hours of light per lamp for the year.

The city is divided into three districts having 7,911, 7,934 and 3,278 lamps respectively, the total number of lamps to be included in the three independent bids being 19,117.

Gas Rates in Large Cities

To the list of artificial gas rates in large cities given in the July number may be added the following compiled by the Citizens Gas Company, of Indianapolis, Ind., to show what the 60-cent rate charged by both the companies is saving the consumers at the same time that the company named is paying 7 per cent. dividends on its stock:

City.	Gas per 1,000 Ft.
Albany, N. Y.	$1.00
Baltimore, Md.	.80
Boston, Mass.	.80
Bridgeport, Conn.	1.00
Buffalo, N. Y.	1.00
Cambridge, Mass.	.80
Chicago, Ill.	.80
Cleveland, O.	.80
Dayton, O.	.85
Detroit, Mich	.75
Grand Rapids, Mich.	.80
Jersey City, N. J.	1.00
Lowell, Mass.	.85
Milwaukee, Wis.	.75
Minneapolis, Minn.	.85
Montreal, Can.	.95
Nashville, Tenn.	1.00
Newark, N. J.	1.00
New Haven, Conn.	.90
New York, N. Y.	.80
Ottawa, Can.	1.00
Philadelphia, Pa.	1.00
Pittsburg, Pa.	1.00
Portland, Ore.	.90
Providence, R. I.	.85
Rochester, N. Y.	.95
St. Louis, Mo.	.80
San Francisco, Cal.	.80
Seattle, Wash.	1.00
Spokane, Wash.	1.50
Syracuse, N. Y.	.95
Toledo, O.	.70
Toronto, Can.	.70
Winnipeg, Can.	1.20



LEGAL DECISIONS

Decisions of the Higher Courts of Interest to Municipalities

Street Reconstruction and Repair—Whether work to be done on a city pavement is reconstruction, or merely a repair thereof, depends on the character and extent of the work itself, and not on what it is called in the proceedings taken therefor. Where there is a dispute as to the nature, character and extent of the work to be done in improving the pavement of a street, the question whether the work done is reconstruction or merely a repair of the pavement is for the jury, under proper instructions defining what constitutes each.—Parker-Washington Co. v. Meriwether et al., (Mo.) 158 S. W. 74.

Eminent Domain—Damaging Property by Public Improvement—Compensation—Defendant levee district, having been organized pursuant to Rev. Civ. St. 1911, tit. 47, proceeded to construct a levee near the city of Fort Worth adjacent to a point on the Trinity river, where the city maintained a pumping plant. It appeared that during the highest flood the pumping stations had not been seriously flooded, but that with the construction of the levee the plant in ordinary flood times would be submerged approximately five feet, and that by reason thereof the machinery would be damaged and the city and its inhabitants deprived of a water supply. Held, that such injury amounted to a direct invasion of the city's property so as to destroy it for its accustomed use, constituting an actual appropriation thereof, and hence the city was entitled to an injunction restraining the completion of the work until compensation had been provided and paid, according to Const. art. I, sec. 17, prohibiting the taking or damaging of any person's property for public use without providing compensation.—Fort Worth Imp. Dist. No. 1 v City of Fort Worth, (Tex.) 158 S. W. 164.

Municipality Liable for Sewer Constructed Under Void Contract but Afterwards Utilized Legally—Where a contract for the construction for a village of a sewer system was invalid for non-compliance by the village with the general village law, but the village thereafter took proper proceedings under the law for the construction of a system and appropriated and utilized the work done and materials furnished by the contractor, it was liable to the contractor for the work done under the contract.—Ward et al. v. Kropf, Pres. of Waterloo, (N. Y.) 101 N. E.469.

Franchise Construed in Favor of Public—City May Construct Plant—Appraisement not Notice of Purchase—A grant of a franchise or privilege is to be strictly construed in favor of the public. Whatever is not unequivocally granted is withheld, and nothing passes by implication. A provision, in an ordinance granting a franchise to a water company and contracting for hydrants, that during the term of the grant the city would not "contract with any other person or persons, corporation or corporations, for a supply of water," does not preclude the city from constructing a water system of its own during the term. Where an ordinance granting a franchise to a water company gave the city an option to purchase its plant at a value to be fixed by appraisers, and provided that in case the city decided to purchase it should serve notice of such determination 6 months prior to the time the purchase was to be made, but did not specify whether such notice should be given before or after appraisal, a mere request by the city for the appointment of appraisers did not bind it as an election to purchase, after the appraisers had failed to agree. Washington-Oregon Corp. et al. v. City of Chehalis, et al. 202 Fed. 591.

Streets—Liability for Injuries—A city constructing and maintaining an inadequate water intake in the improved part of a street at an intersection where pedestrians had a right to cross, and allowing it to be concealed by weeds, so that, after an erosion around it, it became a trap, was liable to a pedestrian injured thereby. Twedell v. City of St. Joseph (Mo.) 152 S. W. R. 432.

FIRE DEPARTMENT *squad of St. Paul, Minn., including*

MOTOR DRIVEN

WITH a view toward promoting higher efficiency among the hundreds of fire departments throughout the United States, MUNICIPAL ENGINEERING *inaugurated a contest two months ago which has resulted in the gathering of valuable information on the subject "Care of Motor Driven Fire Apparatus."*

A series of cash prizes were offered as an incentive to command the attention and interest of leading fire department authorities throughout the country. As a result a great number of valuable articles were submitted for the consideration of the editors. The editors selected a committee of five disinterested parties, familiar with the subject of motor fire apparatus, to whom the articles were submitted. Their award of cash prizes is as follows: 1st J. M. Taylor, Springfield, Mass.; 2nd F. H. Bemis, St. Paul, Minn.; 3rd P. J. Reddy, Capt., Cleveland, Ohio; 4th D. J. McCue, North Braddock, Pa.; 5th O. B. Mercer, Chief F. D. Westville, Conn.; 6th R. F. Turner, Jacksonville, Fla.

From month to month these articles and some of the others submitted will be published.

When this contest was started it was with the distinct understanding that it was not to be a literary competition, and that articles would be judged solely on the merits of the facts presented. Our readers are therefore presented with facts, which in some cases are a little homely in wording and phraseology, but that are nevertheless from men who are best qualified to judge of what is necessary to secure efficiency.

One of the qualifications of this contest was that none would be allowed to enter except those actually connected in an official capacity, or as an

the chief, his lieutenants and the emergency squad machine.

FIRE APPARATUS

employe, in a fire department. The publishers solicit criticisms and suggestions on the articles presented. If there are others who consider that they have in operation more efficient methods than those described, we should b very glad to receive articles from them.

This is the first contest, to our knowledge, which brings to a focus the experience of fire department officials on the proper care of motor driven apparatus. The articles themselves and the discussions which will undoubtedly follow will be of great value to those who have adopted or are contemplating the adoption of this comparatively new method of protection of property. *THE EDITORS.*

Care of Motor Fire Apparatus

By F. H. Bemis, St. Paul, Minn.

The motor is the first consideration in motor-driven fire apparatus, and the fuel is one of the very important elements in its operation. As good coal is essential to raising steam pressure in a boiler rapidly, so are good gasoline and lubricating oil necessary in making quick starts with a gas engine. To use either poor coal or gasoline is false economy where time and efficient operation are so absolutely necessary.

All gasoline engines use a carbureter, or vaporizer of some kind, to mix the gasoline with air, the correct proportion being about fifteen parts of air to one of gasoline for the best explosive mixture. The gasoline is regulated by a needle valve on most makes of carbureters and the air by numerous kinds of valves or ports, one air port must be always open. In addition there must be an auxiliary air valve which begins to open as the motor gains in speed. This must always be tightly closed when starting the motor, as any extra amount of air will cause difficult starting. There are also several devices

on the market for increasing the air supply from the dash. A device of this kind is very useful, for when the engine is warm more air can be used than when cold, which results in the saving of gasoline.

For ease in starting the motor, the operator should have a means of closing or partially closing the air intake to the carbureter, also a priming valve, such as a pump to draw gasoline from the supply tank and thence force it into the intake manifold. Care must be used not to flood or overdose the engine with gasoline, as this will make trouble instead of giving assistance. Two tablespoonsful are sufficient for any motor under 100-h.p. Good compression is essential to easy starting.

A gasoline strainer is very important. One should be placed on the end of the pipe leading into the tank and extend a couple of inches inside of it; one also on the end near the carbureter. This will hold back most of the dirt which somehow or other finds its way into a tank. It is best to strain galosine thru a chamois skin. Also a water trap should be placed between the carbureter and the tank, to catch any water which might be in the tank. Water is sure to accumulate from condensation or sweating and will give rise to trouble if it reaches the carbureter.

PROTECTION of air ports important in preventing the clogging of the carburetor and also fires caused by back-firing of motor.

All intake air ports should be protected from dirt with a screen of fine mesh, as any dirt or other substance, such as waste or bugs, will be drawn into the carbureter and possibly cause trouble. Another advantage is the prevention of fire. Nine out of ten auto engines and machines catch fire from a premature explosion; i. e., the gas is ignited in the cylinder before the intake valve has closed, thus allowing the flame to pass back into the carbureter and ignite the gasoline which remains in the air inlet pipe. If this pipe or port is covered with the wire gauze, the flame will be stopped by the gauze.

Cold weather necessitates a water jacket around the carbureter, which, if possible, should extend part way up the manifold, the jacket to have a pipe leading in and one out in connection with the water circulation of the engine, with means for adjusting the flow thru the jacket. This will cause the gasoline to vaporize more easily and prevent freezing or frosting of the carbureter in zero weather. Also the air intake should lead to the exhaust pipe, not touching, but close enough so that the heat from the exhaust pipe will be drawn thru it into the carbureter.

The double system of ignition is preferable; that is, two independent sets of spark plugs, one taking current from a battery and the other from the magneto, with a switch arrangement allowing the motor to run on one set alone or both together. This insures a spark in all cylinders as far as the plugs are concerned, and when water is wanted or an alarm comes in there is no time to change a plug, and it is a rare thing for both plugs in any one cylinder to get out of order at the same time. Also using two spark plugs in a cylinder gives a slight increase in power. The space between the points of spark plugs is important. I find that for hard service the battery plugs should have a space of 1/16 of an inch; for the magneto, 1/32 is enough. A plug with four sparking points is best for the magneto plugs. All plugs should be protected from water, in order to prevent cracking of the porcelains.

LUBRICATING oil should be drained every two hundred and fifty miles, and kerosene run in the motor to cut carbon and old oil.

When the lubricating oil becomes dirty or black, as in running 250 miles, or after a long period of pump operation, the oil should be drained from the engine, and kerosene used to clean out the pipes and crank case. All kerosene should be removed before adding fresh oil. It is also good practice to flush the engine (while the motor is running) with kerosene. This is best accomplished by dribbling and tapping the intake manifold to take a small pet cock; a rubber tube can be pushed over the end of this; then drop the free end in a quart of kerosene; the suction of the pistons will draw the liquid into the cylinders, care being used not to stall or stop the motor; the flow can be regulated from the pet cock. The kerosene will loosen and soften any carbon that may be on the valves or in the cylinder; it will also cut any of the dirty or gummy oil from the piston rings or spark plugs. After using the kerosene in this manner, the motor will speak for itself by running smoother and starting better. The pet cock must be kept closed when not in use. The last word on the engine is, keep it clean and well oiled.

On motor-driven apparatus a bell is practically useless, for the reason that the sound of a bell will not carry far enough to give sufficient warning of the approach of fast-moving fire apparatus, and the apparatus may be mistaken for a street car or ambulance. I am speaking from personal experience of five years' driving of motor apparatus. The best warning is the siren horn. One of these horns has a sound all its own, and if used exclusively by fire apparatus the traffic

knows what is coming, and the horn can be heard a mile, giving anything time to get out of the way. If the flexible shaft drive is used, the horn should be placed in as straight a line as possible with the driving pulley and kept well oiled, and the couplings should be looked over often to see that they are tight, as without the horn working the efficiency of the machine is cut in half.

The main point in the care and maintenance of any motor fire apparatus is to have an experienced man behind the wheel.

The brakes need considerable attention and should be adjusted evenly. When the brake pedal is applied it is essential that one exert the same pressure as the other. If one brake band holds better than the other, a machine is very much more apt to skid than if they both grip with the same pressure. Also more time is consumed in coming to a stop. To adjust the brakes evenly, jack up both rear or driving wheels, first blocking the front or steering wheels; see that the brakes are not holding with pedal released. Then start the motor and put the gear lever in second speed, allowing the wheels to spin. Now apply the brake, taking notice which wheel stops first. If one stops sooner than the other, very little taking-up of the other will cause them both to stop at the same time. The brake drums must be kept free of all grease or oil and should be looked over after every run. Grease on the brake drums has caused many accidents.

IN THIS instance electric lighting has proved the most satisfactory.

For lighting purposes the best, in my experience, is to have an electric generator driven by silent chain belt from the water pump shaft or magneto shaft. For lights and ignition, 6 volts, 10 amperes are large enough to keep a 100-ampere-hour battery supplied with current to light headlights, taillights and inspection lamps. The generator should have an automatic cut-out to prevent burning out or overcharging the battery. A system, such as described, has given perfect satisfaction at all times for the last five years, and is still in use. Once a year the battery must be washed out and new electrolite added, and while in use should not be allowed to run dry; the plates should be kept covered, and only distilled water should be used.

Skid chains are necessary on the tires which do the driving, when there are wet streets, loose sand or snow to run over. The chains should never be adjusted very tight, nor should springs be used to draw them tight to prevent rattle. Let them rattle a little, and the tire will wear longer, for if the chain remains in one place there will be excessive wear on the tire at that point. The chain should be as tight as it can be drawn with the hands. For chiefs' autos or the squad wagons a chain on the left front wheel is advisable to prevent a front skid when turning corners in snow or mud. The only thing possible to do when the front starts to skid is to stop if you can.

For motor-driven apparatus the following places should be provided with grease cups of ample capacity: All spring shackles and end joints; steering gear box, and all friction joints of steering gear; on the pump used for water circulation; on both bearings of the siren horn; and all friction joints on the rear axle construction. Small oil cups are more trouble than use, as they will clog in spite of any care they receive. Good force grease cups are sure and cleaner in every way.

KINDS of tires to use for cars of different weights.

For cars weighing up to five tons, loaded, pneumatic tires are the best, as they ride the easiest with consequent saving to the machinery. Over three tons, the apparatus should have dual tires on rear, all inner tubes to be of extra thickness nearest the tread. There are inner tubes on the market which have tapering walls from one-eighth of an inch at the bottom to five-eighths at the top. With a tube of this kind the outer casing can be worn almost thru without danger of a blow-out or puncture. Also while the car is standing, better support is given the outer casing. The tires should be kept free from oil, as it will soften the rubber, making it spongy. They should be kept well inflated always, as a tire will wear out quicker from being run soft than from any other cause. Do not lower the pressure in hot weather, as any expansion from heat will not injure the tire on the short runs which fire apparatus has. All cuts in the casing should be repaired at once, as dirt and water will work thru and destroy the fabric, causing a tire blister, which will ruin a tire in short order.

Nickel trimming should be used whenever possible, as it is the easiest to keep clean and always looks neat and stays clean the longest.

International Association of Fire Engineers

The forty-first convention of the International Association of Fire Engineers, beginning September 1, had the difficulties regarding regularity of attendance

which seems to be inherent in conventions held in New York and other large cities, but accomplished marked results particularly in the discussion and elucidation of the questions of motor apparatus, fire prevention and incendiarism.

Among the valuable papers on motor apparatus were those on "British Motor Fire Engines," by Arthur R. Dryer, delegate from the fire brigade of London, England; "Durability, Efficiency and Economy of Motor Fire Apparatus," by Chief A. V. Bennett, Birmingham, Ala.; "Defects and Cost of Maintenance of the Motor Pumping Engine," by Chas. S. Demarest, chief of construction of New York fire department.

A twelve-hour test of motor pumping engines was made on Wednesday, September 3, in which there were eleven entries. It demonstrated the efficiency and reliability of the motor apparatus. The entries, with their capacities in gallons per minute, were as follows: 1, Seagrave, 1,000 gal.; 2, Ahrens-Fox, 700; 3, American-LaFrance, 700; 4, Luitweiler, 600; 5, American-LaFrance, 1,400; 6, Knox, 600; 7, Nott, 600; 8, Robinson Jumbo, 750; 9, Nott, 800; 10, Robinson Monarch, 900; 11, Waterous, 700 gal. Nos. 1, 2, 5, 6, 8, 9, and 11 were still in operation at the end of the test and the log showed that Nos. 1, 2, and 11 lost no time during the test, tho No. 1 required 20 minutes to get water at the start on account of a leaky suction joint.

No. 4 dropped out of the test in the ninth hour on account of hot bearings; No. 7 in the ninth hour on account of leaky cylinder gasket letting water in; No. 10 in the tenth hour on account of leaky pump valves; No. 3 in the eleventh hour on account of fire pump bearing, followed by motor trouble after bearing was repaired. All engines started with large nozzles, 1¾ to 2¼ inches, and pump pressures of 120 to 130 pounds, showing slightly above or below their rated capacities with the nozzles and pressures used, except No. 4, which was 103 gallons below its rated capacity. From time to time the nozzles were changed for progressively smaller sizes, those finishing the tests having 1 to 1⅝-inch nozzles in use at that time with pump pressures of 192 to 296 pounds. The troubles requiring stoppage were nearly all pump and bearing troubles and the few engine troubles developed, with the exception above noted, did not cause stoppage, being adjustable while running.

The exposition of fire apparatus and supplies also demonstrated the advance in motor fire apparatus, practically all the apparatus exhibited being of this type. Among the exhibitors of fire apparatus were the Knox Automobile Co., of Springfield, Mass.; the American LaFrance Fire Engine Co., of Elmira, N. Y.; the Seagrave Company, of Columbus, O.; the Ahrens-Fox Engine Co., of Cincinnati, O.; the Nott Fire Engine Co., of Minneapolis, Minn.; the Waterous Engine Works Co., of St. Paul, Minn.; Pope-Hartford Co., of Hartford, Conn.; James Boyd and Brothers, of Philadelphia, Pa.; the Robinson Fire Apparatus Mfg. Co., of St. Louis, Mo.; the International Motor Co., of Rochester, N. Y.; the Martin Carriage Works, of York, Pa.; the White Company, of Cleveland, O.; Peter Pirsch & Co., of Kenosha, Wis., by photographs. Tractors for use with fire apparatus were shown by the Martin Tractor Co., of Springfield, Mass.; the American and British Mfg. Co., of Providence, R. I., and Christie Front Drive Co.

The discussion of fire insurance, incendiarism," by oJseph Johnson, fire comall sides of these questions. There were many valuable papers, such as those on "Fire Insurance and Its Relation to Inceudiarism," by Joseph Jefferson, fire commissioner of New York, and Frank Lock, New York manager of the Atlas Insurance Co. of London; "The Relation of Incendiarism to the Fire Loss," by John Kenlon, chief of New York fire department; the discussion by F. M. Griswold, of the National Fire Protection Association; "Inspection of Buildings and Contents by Unlformed Members of Fire Departments," by H. C. Bunker, chief of fire department, and D. F. Cash, director of safety, of Cincinnati, O.; "Fire Prevention and Uniform State Fire Marshal Laws," by Eugene D. Stocker, deputy state fire marshal of New York; "Fire Prevention and Fire Protection," by tSate Fire Marshal Thos. J. Ahearn, Albany, N. Y.

The officers elected were: Thomas W. Haney, Jacksonville, Fla., president; Hugo R. Delp, Lansing, Mich., and Harry L. Marston, Brockton, Mass., vice presidents; James McFall, Roanoke, Va., secretary; George Knofflock, Mansfield, O., treasurer. New Orleans, La., was chosen as the next place of meeting.

Maintenance of Tractor Motor.

By P. J. Reddy, Captain of Hook and Ladder Company No. 1, Cleveland, Ohio.

The largest piece of fire apparatus in use is operated by Hook and Ladder Company No. 1, of Cleveland, O., of which P. J. Reddy is captain.

The machine is described by L. A. Quayle, assistant engineer of the division of power, and the method of maintenance and operation of the motor is given by Captain Reddy in an article which received the third prize for articles concerning maintenance of fire department motors.

The following outline will give an idea of the system of maintenance followed:

One man is placed in charge of the motor. However, it is necessary to have at least four men capable of operating the machine, on account of days off, meal hours, and leaves of absence. When No. 1 is on duty he takes charge and cares for the motor; when he is off duty, then No. 2 takes his place, and so on with No. 3 and 4, there being one man always responsible. These men are interested in motor apparatus and are men of good judgment. We have drivers who have never operated an automobile prior to being instructed on this apparatus, and they have proved to be excellent.

The care of motor apparatus involves several important functions which are, in the main, proper management, caution and economy.

Now, where, when and how shall these be accomplished? In all fire departments there are three places, namely: In quarters, on the road, and at fires, each to be considered and governed separately.

Answering the first, at quarters, after returning from a fire or a run, the motor must be gone over systematically and carefully. No matter what the hour of the day or night may be it must be ascertained that every part is in perfect order for the next run. A hurried inspection will not do, with the idea in mind that anything that may be wrong can be repaired or adjusted the next day. A nut or bolt might be loose and for the want of immediate attention it may work out and disable the motor before the next run has been completed.

A periodic inspection must be given the ignition wiring, ascertaining that it is in perfect condition. Inspect the batteries, see that there is the proper amount of water (distilled) above the plates; see that the dry cells test out to their proper voltage; see that vibrators are not pitted and sticking; see that the coil box is kept dry from rain or other wetting; see that the spark plugs are not broken or set too far apart. The magneto must be kept clean, dry and covered with leather boot. The oiler must be inspected regularly, this being a particular part. Have the oiler properly adjusted, have plenty of oil, see that none of the oil pipes are clogged with bits of waste, or other dirt; see that the valves are properly set and the engine properly timed. The carbureter must be adjusted for weather conditions, giving a richer mixture in colder weather than in warm. Have all bolts tightened after every run, keep the brakes properly adjusted; see that the drive chains are kept clean and free from dirt, lubricating them with graphite mixed with oil; keep the grease cups well filled and turn them down at least once a week; keep the engine clean and properly oiled; see that the lamps are in good working order for night service.

Have your spark and throttle set at proper place for immediate use. Do not allow them to be moved after they have been set. It is very important that they be ready at all times for the immediate starting of the motor.

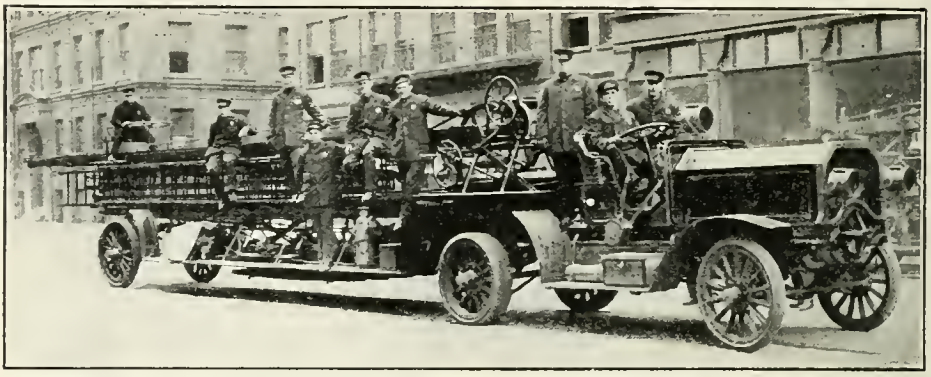
Remember to have the gear shift levers in neutral and do not have the emergency brake set in quarters. At least every two months the wheel bearings should be inspected and greased if necessary. Be careful to keep the tires free from oil, as lubricants rot rubber quickly and cause the outer casing of rubber to separate from the fabric.

After periodic and proper attention has been given to the ignition, timing gears, valves, cylinders, bearings, engine, bear box, brakes, batteries, clutch, springs, greasing, oiling and all other accessories, we come to the consideration of what is necessary in answering an alarm.

When starting out to a fire, start on the battery, then be sure to switch over to the magneto. Advance the spark to its highest point or where it gives the best service. In changing gears do not attempt to force them into mesh, as a great many gears are stripped by constant forcing, a habit which is easily acquired in the anxiety to get under way quickly. When changing gears do not let the clutch in too quickly, but gradually, with the motor getting enough gas to keep the apparatus under the headway secured at the various gear speeds. The apparatus should have sufficient headway to admit of the change to second without imposing any more effort or strain on the motor than it was subjected to in the first speed. When

changing from a second to third the apparatus should be going at a speed of about 5 miles per hour. When changing to fourth the speed should be about 10 miles per hour and the machine should always be on a straight road before the gears are changed.

When approaching a corner or vehicles, precaution should be taken by disengaging the clutch and applying brakes lightly, so as to be under control in case of some unforeseen danger. By observing the precautions mentioned it will usually not be necessary to use the emergency brakes. Their continual application on a grade, different surface condition, etc., the foregoing is the procedure we follow and by which we have obtained the best results. In reversing the apparatus be careful to completely mesh the gears and do not force them into place. Constant forcing sooner or later chips the edges of the gears, which reduces their surface of contact and ultimately causes them to strip. We have known of cases where large pieces have been stripped off, and have caught between the gears, with the result that on the following revolution shafts have been sprung and bearings thrown out of alignment.



SEAGRAVE *tractor which has motorized a large hook and ladder. This apparatus is one of the largest of its kind in use.*

heavy fire apparatus is bound to subject the tires to wear as well as the apparatus. Great care should be taken in judging distances, as in passing of street cars or vehicles which may be standing on streets.

When passing cross-overs, railroad tracks, holes, bumps, etc., the engine should be slowed down in order to lessen vibration as much as possible. A great many breaks occur by failing to observe this precaution. Upon approaching railroad crossing sufficient power should be available to pull the apparatus over with safety. The safest method to follow when handling heavy apparatus is to approach such difficult situation on a higher gear than to drop to a lower. The delay due to stalling and starting the motor again may often be sufficient to result in a serious accident.

When going down a hill disengage engine and apply emergency brakes enough to be in safety and foot brakes if necessary—it being best to be always in gear. In coming up hill keep in low gear and retard spark to the most advantageous point, and allow enough of the throttle to be open so as not to stall engine. The best methods of making hill runs are difficult to explain as each hill has a different

We now come to the third consideration, the care of apparatus at fires.

When arriving at fires where motor may get wet, either by rain, or by water from the hose lines, and in winter by snow, there should be a canvas carried, large enough to cover the entire machine. The emergency brakes should be set, gear shift levers placed in neutral, the magneto and switch turned off. Also have throttle and spark shut off and at night place red lanterns on outside, both front and rear.

In freezing weather turn the engine over frequently where there is a long stand at fires. Before returning from fires to quarters inspect the apparatus to see that chains, brakes, etc., are in proper order.

By carefully following this routine the motor apparatus will always be in condition for efficient service. Constant attention to details is essential. The men who are responsible for the care of the machines must be held to rigid observance of their duties. Neglect of one little thing leads ultimately to the overlooking of more important matters, and inasmuch as automobile apparatus performs one of the most important functions to which motors have yet been adapted it is of the

very highest importance that an apparatus of this type be always kept as near 100 per cent. efficiency as is possible for human intelligence to attain. Otherwise losses of great seriousness will occur.

Comparative Operating Cost of Seagrave Tractor and Horses

By L. A. Quayle, Asst. Engineer, Division of Power, Cleveland, Ohio.

Whenever the opportunity occurs, Cleveland's director of public safety, Mr. Charles W. Stage, is supplanting the slow and expensive horse with the speedier and more effective motor or tractor. That this policy increases the efficiency of the fire department and decreases very materially its operating cost, is clearly shown by the following carefully compiled data.

Located within one-quarter of a mile of the public square and from one to three blocks from the long steep hills leading down to the flats along the Cuyahoga river, where the large lumber yards and factories of all descriptions require constant protection, Hook and Ladder Company No. 1 renders the severest service which firemen and fire-fighting apparatus are called upon to perform.

DESCRIPTION of one of the largest motor-driven hook and ladder equipments in present use.

The hook and ladder truck shown in the Illustration is equipped with 345 feet of ladders, 840 feet of life lines, a powerful search light, a pulmotor, an oxygen helmet, life nets, etc., and with its complement of 15 men weighs approximately 8 tons. Formerly three horses were used to pull this truck on level ground, and five were required to haul it up the hills which lead from the flats.

The 90-h.p. Seagrave tractor shown in the illustration has drawn the ladder truck to 215 fires in its six months of service without a moment's trouble in spite of the fact that 80 of these calls were down on the flats, and many times the tractor had to pull up the long steep hills when they were covered with snow and ice. The wheels are 40 by 6 inches, rear wheels dual tires, wheel base of tractor 142 inches, distance between rear wheels of tractor and rear wheels of truck 29 feet 5 inches. The weight of the tractor is 5.1 tons.

After each of these runs the truck was back in the engine house and ready for another call from 15 to 20 minutes before the horse-drawn fire engine returned.

The Seagrave tractor is equipped with a 7¼ by 7¾ four-cylinder engine. A fan mounted on the engine shaft furnishes a blast of air which is conducted thru jackets surrounding the cylinders, and cools them very satisfactorily. A magneto, storage battery, and dry battery are kept in readiness to furnish current to two sets of spark plugs. This tractor ladder truck is 63 feet in length overall, which gives it the distinction of being the longest piece of motor-driven apparatus in existence. The speed of 28 miles per hour which was recently attained on a level road is little short of remarkable when it is considered that the combined weight of the tractor and truck is approximately 13 tons.

COST of operating apparatus with tractor as compared to horses.

The item next in importance to its absolute reliable and efficient service is the tractor's cost of operation compared with the horses it displaced. Altho but three horses were used for pulling the ladder truck on level ground, on account of the severit yof the service, four horses were kept for use on the truck in order to insure the readiness of at least three at all times. The team used for helping the three horses pull up the hills from the flats was used for delivering general supples to several of the fire stations, and no charge is made against the horse-drawn truck for their use.

The average life in service of a Cleveland fire department horse is very nearly eight years but should be five years or less for most efficient service. The last six horses purchased by the fire department cost $300.00 each, which is a comparatively low price. The average cost of keeping fire department horses including feed, harness repair, shoes and veterinary attention, fluctuates between $20.00 and $25.00 per month, and averages approximately $23.00.

The Seagrave tractor cost $4,000 and its life under present conditions of use is conservatively estimated at 12 years. In its six months of service it has traveled 310 miles and consumed 105 gallons of gasoline and 22 gallons of lubricating oil. Altho it has already been found necessary on account of the excessive wear, to replace with larger tires those furnished with the tractor, this change is costing the fire department nothing, as the tires are guaranteed for three years by the makers. Summarizing the above data we have:

Capital Expense for Horses.

Four horses, at $300 each	$1,200.00
Three sections of harness, at $60 per section	180.00
Total capital expense	$1,380.00

Yearly Fixed Charges and Operating Expense.

Interest at 4 per cent. and depreciation at 12½ per cent. on $1,280	$ 227.70
Feed, harness repair, shoeing, etc. at $23 per month	1,104.00
Total yearly expense	$1,331.70

Tractor Fixed Charges and Operating Expense.

Interest at 4 per cent. and depreciation at 9 per cent. on $4,000.	$ 520.00
Gasoline, 210 gal., at 16½c	34.65
Lubricating oil, 44 gals., at 30c.	13.20
Repairs and miscellaneous supplies	5.00
Total yearly expense	$572.85
Total yearly expense of horse-drawn truck	$1,331.70
Total yearly expense of tractor.	572.85
Total yeariy saving by tractor	$ 758.85

The saving shown above will be cut down considerably by tire and repair expense after the tractor has been in use a few years, but in any case the saving of the tractor over horses should be considerable. We, therefore, believe we are justified in concluding from the above data that this tractor is just as reliable, much speedier, requires much less attention, and shows a very desirable saving in expense over the horses it displaced.

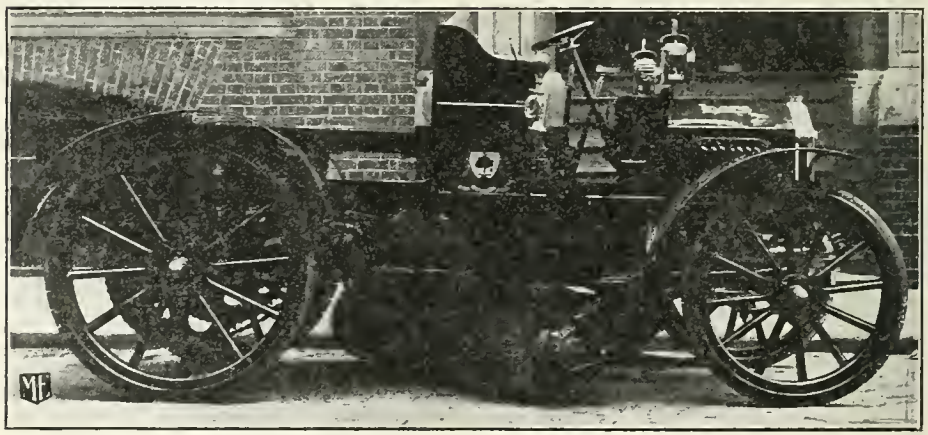
A Motor Road Sweeper of English Design

The accompanying illustration shows an English Lacre motor road sweeper recently put into operation by the Glasgow Corporation. The six-ton gasoline truck used is one employed for mail, fire, ambulance and street sprinklers. This motor sweeper is fitted with an 18-h.p. 2-cylinder engine, and the speed change gear provides three speeds forward and one reverse.

The speed of this vehicle when not engaged in sweeping operations is 4, 8 and 13 miles per hour, but when the brush is working the best speed of the machine for sweeping is about 7 miles per hour, this being done on the second speed. For light surface sweeping, on moist roads, 10 to 12 miles per hour can easily be obtained.

The diameter of the brush is 18 inches and the length, 5 feet. The power to the road brush is transmitted thru the sprocket shaft by means of a dog clutch engaging with the sprocket wheel, and is operated by a lever situated on the left-hand side of the driver's seat in a very accessible position. The brush is raised and lowered by means of a lever, also situated on the left-hand side of the driver's seat, and is controlled by an adjustable balance weight situated on the off-side of the vehicle.

Adjusting brackets on both sides of the brush shaft allow for adjustment and for equal wearing of the brush.



MOTOR ROAD SWEEPER *of English Design.*

MISCELLANEOUS

Wilmington Convention of American Society of Municipal Improvements

The twentieth convention of the American Society of Municipal Improvements to be held at Wilmington, Del., promises to equal its predecessors in interest and value.

Prior to the convention the committees on standard specifications and standard forms will meet with their sub-committees to discuss the reports to be presented to the convention. The first of these sessions will be held at 10:30 Monday morning, October 6, at the Hotel du Pont, Wilmington. Several new sets of specifications will be presented and all persons interested in them are invited to be present and join in the discussions.

The first session of the convention proper will be held on Tuesday morning at 11 o'clock. In addition to the excellent committee reports usually received, the following papers are announced:

On Tuesday: "Separate and Combined sewers in their Relations to the Disposal of Sewage," by John H. Gregory, consulting engineer, New York; "Springfield Sewage Disposal Plant and Its Departure from Common Practice," by Alexander Potter, consulting engineer, New York; "What Obligation, If Any, Is the State Under to a Municipality Where the State Board of Health Has Required the Abandonment of the Disposal of Sewage Into Running Streams," by Chester G. Wigley, engineer for New Jersey State Board of Health; "Some Observations on Minimum Illumination for Street Lighting," by Jos. E. Putnam, assistant city engineer, Rochester, N. Y.; "Education in Fire Prevention," by F. W. Fitzpatrick, consulting architect, Washington, D. C.; "Fire Prevention," by Powell Evans, Department of Public Safety, Philadelphia, Pa.

On Wednesday: "Proposed Standard Specifications for Paving Brick of the American Society for Testing Materials," by Prof. Edward Orton, State University, Columbus, O.; Reports of committees and sub-committees on standard specifications and standard forms.

On Thursday: "The Standard Abrasion Test for Paving Brick, How it Works in Newark," by W. A. Howell, Newark, N. J.; "Making Street Embankment by Rolling vs. Natural Settlement," by Geo. C. Warren, Boston, Mass.; "Control of Sidewalk Construction and Maintenance," by A. Prescott Folwell, New York; the query session is set for Thursday morning.

There will be a boat trip on Wednesday afternoon and visits to city departments on Friday. A. P. Folwell, secretary, 50 Union Square, New York City.

William J. Gaynor

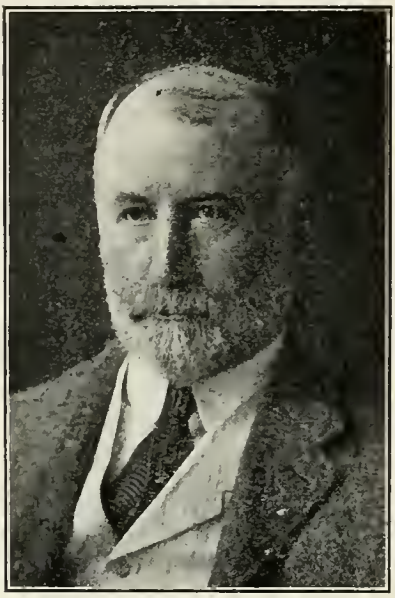
The mayor who, in all probability, has done the most for the people of New York City, has dropped out in the way which every live and growing man would prefer, in the full tide of activity and at the height of his progress. He was but sixty-two years old but in the past thirty years has done more in removing bad political conditions and instituting new and better methods than any other man in the same space of time. He began this kind of work when only thirty years old in the village of Flatbush, now a part of the city of New York, by compelling saloons to take out licenses, and closing them on Sunday, acting simply as a citizen with knowledge of the legal methods of procedure. He moved to Brooklyn when he was thirty-five and began a fight against the McLaughlin ring, then in control, which resulted in his election as justice of the Supreme Court in a contest which finally crushed the ring, and sent some of its members to prison.

After numerous refusals of the nomination for mayor of New York, he finally accepted one from Tammany four years ago and continued his reforms, introducing economies within the first three months which saved the city nearly $2,000,000 a year.

A list of seventy-four good things done under Mayor Gaynor's direction includes work in nearly every department of city government from increasing the credit or borrowing power of the city to better supervision of milk inspection.

The attempt at his assassination made

by a discharged city employe brought him the sympathy of all and would have elected him governor with no appreciable opposition if he could have been induced to accept the nomination.



WILLIAM J. GAYNOR.

He has been accused by petty politicians of all the evil things he has been fighting for so many years and the line up which was forming in the campaign this fall was based to some extent on these misrepresentations, but those who know had the strong belief that he would have been reelected if he had not been so suddenly removed from the race.

Mayor Gaynor has done his whole duty as he saw it at all times. No one is free from mistakes but no one was freer than he from intentional wrong. If every good citizen had the same courage of his convictions, politics would b eclean and city government would be a model of efficiency and economy.

George W. Fuller

The thoro manner in which George W. Fuller attacks any problem before him was first exemplified in the completeness of his preliminary technical training. After graduation from the Massachusetts Institute of Technology, in itself an evidence of a full technical education, he made a special study of sanitary science in the University of Berlin and under several eminent German specialists, returning to spend five years in the study under the Massachusetts State Board of Health of problems of sewage and water purification in its Lawrence, Mass., experimental station, in the creation of the reputation of which Mr. Fuller had a large part.

Mr. Fuller had charge of the experimental work at Cincinnati, O., and Louisville, Ky., on which were based the plans for water purification in those cities. These two investigations occupied four years.

Since that time Mr. Fuller has been in private practice and has been adviser to many municipalities, among them New York, New Haven, Paterson, Washington, Buffalo, Columbus, Indianapolis, St. Louis, New Orleans, Grand Rapids, Minneapolis, Montreal, etc., regarding water supplies and water purification, and

GEORGE W. FULLER.

many others in a number of important water works valuations and adjustments of water rates.

Mr. Fuller is in the prime of life and bids fair to add to the numerous laurels he has already gathered in his professional work.

Publications Received

Report on the Sewage Disposal System of Rochester, N. Y., by Edwin A. Fisher, city engineer. April, 1913. Cloth, 248 pp. Contains all the reports on the subject from that of Emil Knichling, dated February 1, 1907, to those of assistant city engineers, dated March 12, 1913, giving the descriptions of systems and states of contracts to that date.

Annual report of Board of Park Commissioners of Cincinnati, O., for 1912. Paper, 26 pp. Chas. H. Meeds, Park Engineer.

Bulletin of the Alumni Council of the Massachusetts Institute of Technology, Boston, Mass., giving report of the committee on a course in business engineering, and a schedule of a proposed course in engineering and business administration. Paper, 20 pp.

Annual report of the Board of Health of Harrisburg, Pa., for 1912. Paper, 39 pp. John M. J. Raunick, M. D., Health Officer.

Typical Specifications for the Fabrication and Erection of Street Highway Bridges. Paper, 25 pp. Circular No. 100 of Office of Public Roads, U. S. Department of Agriculture. Logan Waller Page, Director.

Annual report of the Department of Public Works of Chicago, Ill., for 1912. L. E. McGann, Commissioner; John Ericson, City Engineer. Cloth, 522 pp.

Eighth annual financial and departmental report of Edmonton, Alberta, Can., for year ending October 31, 1912. William Short, Mayor; A. J. Latornell, City Engineer.

Report of the Chief Engineer of the Board of Estimate and Apportionment of the City of New York, for 1912. Nelson P. Lewis, Chief Engineer.

Twentieth annual report of the Massachusetts Highway Commission, for year ending November 30, 1912. A. W. Dean, Chief Engineer.

Proceedings of the sixth annual convention of the Indiana Sanitary and Water Supply Association. Paper, 223 pp. Dr. W. F. King, Secretary, State House, Indianapolis, Ind.

Proceedings of the fifth meeting of the Illinois Water Supply Association. Paper, 275 pp. Edward Bartow, Secretary, University of Illinois, Urbana, Ill.

Regular publication of *Lefax* data sheets has been delayed by changes in organization. May and June sheets are issued in September. Forrest R. Jones, formerly professor at University of Wisconsin and Cornell University, now has charge of the editorial department. Standard Corporation, Philadelphia, Pa.

Public Utilities, their cost new and depreciation. By Hammond V. Hayes, Ph. D., Consulting Engineer. Cloth, 262 pp. $2. D. Van Nostrand Co., New York.

The Quantity Surveyor is a monthly bulletin conducted under the auspices of the American Institute of Quantity Surveyors in the interest of better methods of estimating on buildings. The organization is being formed in San Francisco with William Mooser and W. H. Ferguson as temporary president and secretary. The first bulletin was issued in August and the subscription price is $1 a year. Address secretary at 571 California street, San Francisco, Cal.

Suggested programs for guidance in the observance of Fire Prevention Day are given in a 16-page booklet to be obtained at 10 cents a copy of the National Fire Protection Association, 87 Milk street, Boston, Mass.

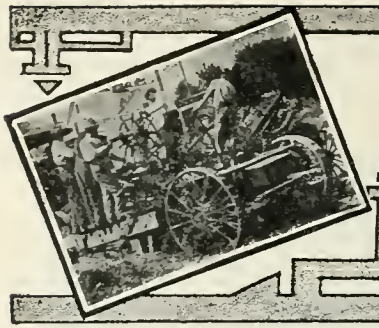
The municipal publication of Baltimore, Md., is named "The Municipal Journal." With the latest number is issued a supplement furnished by the factory site commission, giving a cycloramic photograph of the city, reproduced in a halftone plate, which is 45 inches long and 6 inches wide.

Technical Associations

A committee appointed at a summer meeting of engineers connected with various national and district technical associations has reported a plan for co-operation of the local representatives of these societies in a body to be called the "Affiliated Technical Societies of the City of Atlanta." The membership is to consist of the members of the local sections of the American Institute of Electrical Engineers, American Society of Civil Engineers, American Chemical Society, Engineering Association of the South, American Institute of Architects, and American Society of Mechanical Engineers, and of others that may be formed and admitted at any time. An executive committee composed of one member from each society will manage the organization, whose expenses will be paid by the sections and by individual subscriptions. Meetings of the association will be held quarterly. This report is now before the component sections of the proposed association for their approval and when these assents are received the first meeting of the association will be called.

The State Highway Department of Ohio held a good roads exhibit at the state fair in Columbus, September 1 to 5, with the aid of the Ohio division of the National Highways Association and the Federal Office of Public Roads. In the exhibit were included the experimental roads built some years ago on Nelson avenue and South High street in the outskirts of the city, and daily trips were made over these two roads. Lectures by experts and enthusiasts were given each day.

The little year book of the Colorado Association of Members of the American Society of Civil Engineers shows that this organization, now nearly five years old, is alive and growing. It has 68 members and the list of papers presented last year is of great value. R. W. Toll, secretary, 700 Tramway building, Denver, Colo.



MACHINERY AND SUPPLIES

Pumpage Reduced One-Half by Meters

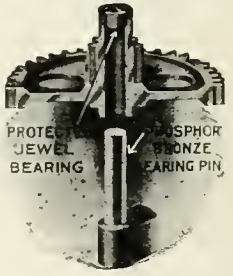
By F. B. Wheeler, Manager City Water Co., Chillicothe, Mo.

Probably the greatest source of loss from which a water works suffers is consumer waste. This is a feature of the flat or scheduled rate method of selling water. Without the meter system, it is impossible for the water works to determine the amount of the water waste. Whether a customer takes 40,000 gallons or 100,000 gallons per annum can never be accurately known where the flat rate method is in use. Each thousand gallons of water has a fixed value to the water works, and it is readily apparent that where a flat rate is employed, the water works department is in a hopeless position when attempting to administer its finances accurately. It is evident to all who have given this subject thought and investigation that the meter system is an actual necessity in the establishment of a fair and equitable water rate. The public is content to pay a meter rate for gas and electricity which allows the concerns supplying these commodities a satisfactory profit. They are just as willing to pay a fair and equitable water rate if water departments would abandon guess-work transactions and employ accurate, up-to-date business methods, the same as apply universally in the management of commercial undertakings.

The water meter will render the same valuable service as the meters are doing which measure gas and electricity. The employment of the water meter system reduces consumer waste to a minimum.

It has been ascertained that 94 per cent. of all the municipal plants use meters on a greater or less percentage of their services, and that the same is true of 88 per cent. of the private plants. In a number of towns and cities, of course, meters are used on a few large consumers only, but when we compare the total number of services with the total number of meters, we find that 41 per cent. of all services in municipal plants are metered and that 45 per cent. of all services in private plants are metered. Private plants that use meters are using them to a greater extent than the municipal plants on the average; but the figures for the number of services added in 1912 indicate that the municipal plants will soon reverse the condition, for it has been ascertained that during the last fiscal year 95.3 per cent. of all new services added in municipal plants were metered. All water works men are, of course, aware of the rapid growth in the use of meters thruout the country, but we believe that most of them will be surprised to learn that more than 90 per cent. of all services added during the past year were provided with meters.

That meters cut down water waste is evidenced by the fact that our pumpage has been reduced by 50 per cent. since we installed the 663 Niagara meters which we now have in service. We still have 350 consumers on a flat rate basis but intend to meter our service thruout in the very near future. We are at present furnishing water to city departments and

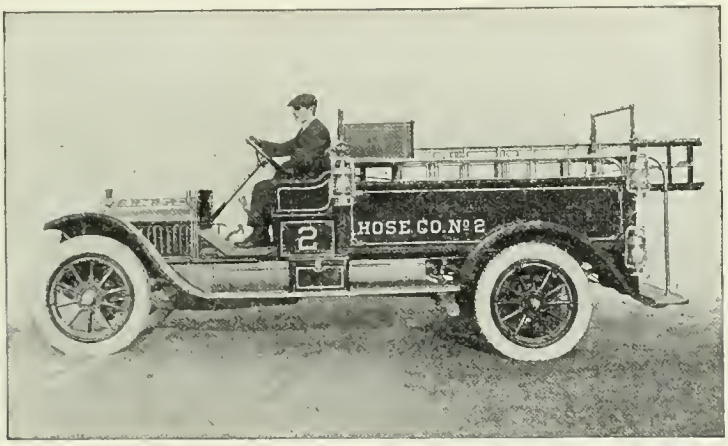


BEARING *and pin construction of a Niagara meter.*

schools in unlimited quantities without payment, altho this is a private company. All of the meters which we have in service are of one make and were furnished us by the Buffalo Meter Company. This type of meter is, we consider, exceedingly ac-

curate in registration, as the weight of the largest gear is carried on jewels which revolve on the upper ends of rigid phosphor bronze pivots, thus preventing any dirt from entering or cutting the gear bearing.

It is impossible to formulate any plan for the adjustment of rates, which would be satisfactory to every community. To enable the water department of any city to be self-sustaining, it is necessary that officials should know exactly what water costs per 1,000 gallons, so that they will be in a position to determine a fair rate at which it should be sold. The surest way to accomplish this result is by metering all the main supply pipes of the city. This plan his been tried with eminent satisfaction.



WHITE *hose truck which displaced horse-drawn apparatus, at an operation saving of* $245 *in six months.*

Motors Reduce Costs

The Young America Hose Company, of Poughkeepsie, N. Y., has employed motor fire apparatus for nearly two years and the officials are firmly convinced of its superiority over horse-drawn apparatus.

In November, 1911, they placed in service a White combination chemical and hose truck, embodying the standard 1½-ton White chassis. It has answered every alarm and has been called upon to make a number of long runs to the suburban sections of Poughkeepsie. Many of the streets on which it must be driven in the city are in poor condition, particularly in the spring, and the districts from which the greater number of alarms are received are often reached only by traveling thru deep mud.

Louis A. Thompson, president of Hose Company No. 6 and chairman of committee on the purchase of fire apparatus, stated that the operative cost for six months amounted to approximately $15, whereas the cost of keeping a team of horses displaced by the White apparatus amounted to $260.

The truck equipment includes everything that is necessary to subdue fires in their early stages, and the company's experience has shown that a ready response to an alarm is often of greater value than the maximum fire fighting ability. With the White combination truck the Young America Company makes a speed of 55 miles an hour on good roads and invariably has a stream of chemical playing upon the blaze before other units of the department arrive.

The truck carries both stationary and portable chemical tanks, and the full complement of nozzles, extension ladders, hooks, axes, etc. The larger stationary chemical tank employs what is known as the Kanawha system in which the creation of pressure does not depend upon the usual chemical action but is accomplished by a powerful auxiliary air pressure system. On the running board of the truck there is a steel tank of compressed air with a conveniently located pressure gage. In the line from the air tank to the chemical tank there is a pressure regulating valve enabling the firemen to admit the air to the chemical in accordance with the requirements of the blaze or the consumption of the chemical. It is possible to have a stream as powerful at the end as it was in the beginning and, unlike other systems, it is not necessary to refill the chemical tank every time it is used.

The fire department of Dover, N. J., is equipped with the most modern fire apparatus both as to vehicles and the paraphernalia. The most recent installation

COMBINATION *hose and chemical truck capable of a speed of fifty-five miles per hour. Manufactured by the White Company, Cleveland, Ohio.*

was a self-starting 6-cylinder, 60-horsepower combination chemical and hose truck, built by the White Company, of Cleveland, O. It is equipped with every device or implement that has a useful place in units of this kind and is so complete in appointments, modern in design and efficient in fire fighting that it was exhibited in the last New York motor truck show as an example of the latest type of combination trucks.

Twelve hundred feet of 2½-inch hose are carried in a steel hose bed, which is quickly accessible from the rear running board. This bed occupies the conventional position between two seats running lengthwise of the truck. These seats, which are capable of seating eight firemen, have cushions that are deep and soft. Beneath each row of seats there are large lockers.

Hand chemical tanks are strapped to the running board and the large nozzles for the 2½-inch hose are carried on posts that are built on the rear running board. Hooks, lanterns, axes, etc., are carried on spring catches and hooks along the side of the body. A 50-gallon chemical tank is mounted in the customary place in a recess between the driver's seat and the hose bed, while the chemical hose, 250 feet long, is coiled in a steel basket immediately above the chemical tank.

For this class of apparatus where seconds count in getting under way, the White electrical starting system is particularly valuable. It has the unusual advantages of preventing the motor from stalling at all times and without any attention on the part of the driver. Both the functions of starting and lighting are performed by the one mechanism, the motor generator, which is mounted at the forward left side of the engine and is driven by silent chain.

Closing the switch connects the 9-cell battery and puts the motor in operation, thus starting the engine. As soon as the latter is turning over at a speed in excess of a few hundred revolutions a minute, the generator being a slow speed type, the voltage of the motor generator exceeds that of the battery, and the battery is charged at all speeds above this point, at a definite governed rate. The 18-volt storage battery is "floated" on the line in such a manner that the motor changes to a generator and back again to a motor accordingly as the electrical pressure rises or falls above or below that of the battery.

At engine speed above a certain definite point it is a generator and below that point it becomes a motor, so that should the engine stall in traffic the electric motor will automatically "pick it up" and restart it without any attention on the part of the driver. It will be apparent that this should constitute a very valuable feature of the motive power of any piece of fire apparatus where the delay incident to having to restart the motor by hand cranking might be serious.

Electrical Equipment Unharmed by Flood

By Wm. L. Fawcett, Milwaukee, Wis.

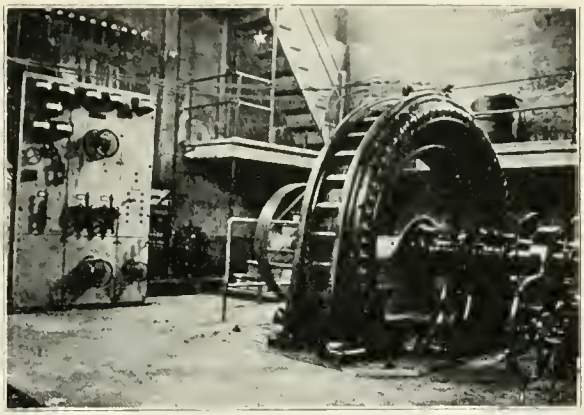
As an example of the care and good workmanship with which present day electrical machinery is produced, and the resulting merit of present day electrical products, I have secured photographs of the effect of the flood which are extremely unusual, and which practically tell their own story.

During the spring and summer of 1910, the city of Black River Falls, Wis., in order to avail themselves of suitable water power purchased and installed an elec-

trical equipment, consisting of a 450-k.v.a., water-wheel-driven, 2,300-volt, 60-cycle, 3-phase, 200-r.p.m. alternating current generator, and a 25-k.v.a., 2,300 volt series regulator and transformer for street lighting, together with necessary switchboard for operating this apparatus, from the Fort Wayne Electrical Works, Fort Wayne, Ind.

This equipment was installed in a concrete block building, erected especially for the purpose, located beside the dam which furnished the necesasry head of water. The machinery, that is electrical apparatus and water wheel, were located below the level of the ground.

During the flood, the power house, just after the dam further up the river had given way and completely overwhelmed the dam at Black River Falls, was completely inundated. It is interesting to note in this connection that the entire basement of the power house was filled with debris and sand to the level of the surrounding ground. Because of extensive damages to the dam the work of reclaiming the electrical equipment was not started for over a month, the apparatus remaining in the wet sand for that period. At that time the basement of the power house was cleared, and the generator raised about four feet from the floor to protect it from the water which drained into the basement. In the meantime the switchboard instruments, potential and current transformers, and the operating coils of the oil switches were returned to the Fort Wayne factory and put in good condition.



VIEW *of same equipment after removal of debris shown in cut below. After thorough and careful cleaning the apparatus operated up to its original efficiency.*

After about 15 months had elapsed to allow for the rebuilding of the dam, all preparations were made to again start operations. The generator was placed on a short circuit run for nearly four days and then put into operation and is operating at present and shows no effect of submersion. A peculiar incident occurred when it was decided to start street lights. The transformer which is used in connection with the Fort Wayne regulator was found to be full of water and frozen solid. A fire was built, the ice thawed, and the water removed, new oil was placed in the transformer and the outfit was placed in service and no trouble experienced. It should be noted that this transformer was filled with water for almost a year and a half.

INTERIOR *view of power house, Black River Falls, Wis., May 21, showing electrical equipment buried beneath tons of sand and other debris.*

Selection of Combination Equipment

By J. M. Donahue, Elyria Construction Co., Elyria, Ohio.

The tendency of most contractors is to buy too many pieces of equipment. Machinery deteriorates and it is an easy matter to wrap up good money in machines which can be used only for a specific purpose. Machinery when given the proper care will last longer when kept in almost constant service than when permitted to stand idle and rust. Ready cash is much better to have on hand than idle machinery. More money expended for higher grade machinery that will do more than one kind of work is the best policy.

Labor is scarce in nearly every section of the country. Wages are high. The cost of materials is increasing. Competition for contracts is keen and this makes prices low. To face these conditions, hand work must not only be eliminated in every possible instance, but only that class of machinery which will do the greatest variety of work must be purchased.

How to decide what outfit to use is often difficult. There cannot he any hard or fast rule laid down. If a man only knows of a few different machines adapted to the work, to arrive at a decision will be easy, but the chances will be that the machine selected, with its accompanying methods, will not be the most economical. In making selection of equipment, many contractors are not open-minded. They conceive the idea that a certain machine is the best suited for the work, and no matter what others say or what information is obtained showing advantages of other machines, the one originally decided upon is purchased or hired and put to work. Before any machine is selected the merits of every one that can be used should be gone into. Also every way that each machine can be worked should be considered.

Cost data on operating each are valuable, but should not be relied upon entirely to arrive at a decision, even if all costs were kept by the man to decide the question. The value of cost data is to check up the estimated cost of the work to be done. No two jobs are exactly allke, so it is never possible to use the costs of one to predict the cost of another. To do so will mean to come to grief sooner or later. Instead one must learn of the output of machines under different conditions, and then with this as a basis the cost of the proposed work, if done by the different machines, can be estimated.

The method is to list the cost of operating each machine, setting down the cost of crew, the cost of water, fuel, oil, repairs and all other items. Then the cost of serving the machine and for getting away the spoil must be listed out in detail. In getting these details of cost, both in estimating them and in checking them, is where the cost data from other jobs are useful. Many details will be similar, as the crew, the amount of fuel consumed, the cost of oil and other lubricants. With every detail of cost estimated, then the unit cost of work can be calculated per day by dividing the total cost by the estimated amount of work that can be done each day. This result must be checked up with other work if possible. To the unit costs thus obtained must be added a percentage to cover overhead charges, and another percentage to cover depreciation of machines. The total will give the unit cost If work is done the entire year, but on many classes of work in some sections of the country work must be shut down for part of the year, and as some expenses continue, this must be reckoned up and added to the cost. Some contractors then add a per cent. for contingencies, but the writer does not believe in this, as the costs should be estimated in great detail, every little item considered, and if wages are placed high and the prices of materials obtained on contracts, then the unknown quantities are eliminated, and thus contingencies are not needed. With such estimated costs for each machine that could be used on the work, it is now possible to decide in an intelligent manner the best machine to use, and this point once decided, the methods of doing the work can he mapped out. Mistakes can be made by following this mode of arriving at a decision, but they seldom occur, while it can be stated that in most cases, decided in the haphazard manner, the worst decision is made.

We have been operating, for several seasons, three Huber rollers, which we find equally adaptable for rolling, hauling and scarifying. The scarifying attachment is built to, and made a part of, the roller outfit. Nine heavy spikes, properly shaped and spaced, are attached to the front of a heavy Z-shape bar, as long as the width of the roller at the rear. This bar is connected by strong rods to the rear axle on which all the pulling strain comes. The shape of the spikes is such that as the roller travels forward they are drawn into the ground, tearing and breaking it up to a sufficient depth to leave the whole mass loose and in condition to be easily shaped up by the grader. When not in use, the spikes are carried clear of the ground and high enough that they do not interfere with the other use of the roller.

The spikes are raised and lowered by steam power. A simple cylinder is placed beneath the rear of the boiler and steam is conveyed to it by a pipe from the top of the boiler. The valve admitting steam alternately to either end of the cylinder is operated by the straight lever at the platform. As the piston travels forward or backward, motion is transmitted to the spike bar, raising or lowering it. When the scarifier is thrown down, the spikes are held in the ground by steam pressure. This gives cushioned compression. If solid rock should be encountered, the piston working against the steam will permit the spikes to raise enough to pass over, but they are forced down again immediately after passing.

The steam pressure feature assures uniform working depth of the spikes at all times, and that, no matter what the position of the roller wheels on an uneven road, the scarifier will follow the surface and tear up to same depth in low places as on high spots. Another advantage is that the surface of a street may be broken up right to a crossing, then the spikes raised and carried across and dropped down exactly at the other side, without disturbing the walk or delaying the machine. It takes but a fraction of a minute to raise or lower the scarifier, and the whole operation is controlled by the one lever. The boiler of this outfit is high mounted, and this allows plenty of room for attachment of the cylinder beneath. These combination machines were furnished us by the Huber Manufacturing Co., of Marion, Ohio.

We find the operation of this type of roller exceedingly economical, as it is sufficiently powerful not only to pull thru the hardest roadbeds, but to hold this attachment in place as well. Since the scarifier does not jump or rise to the road surface, it is not necessary to retrace the work.

Then the added tractor advantages mean a considerable saving. It is for these reasons that we favor the purchase of combination equipment in every possible instance.

Our experience shows that hauling with the Huber roller is cheaper than team hauling for the same distances, and that economy increases with the length of the haul up to the maximum. The cost per cubic yard for hauling crushed stone with this outfit is about 60 per cent. of that of team hauling for one mile, and about 40 per cent. for distances of three miles. This includes the pay of operator for the engine (who is paid straight time regardless of the condition of the weather and whether the job is running or not), the cost of fuel, and supplies for the roller and the cost of maintenance.

Prevention of Meter Freezing

The setting of water meters is one of the most important phases of water works maintenance and extension. Altho manufacturers have done all possible to improve the durability and accuracy of meters, and altho water works managers and superintendents have conducted careful experiments and tests in order to determine the types and sizes best suited to perform satisfactory service under local requirements, the matter of locating and setting meters has received little attention.

Having purchased the meters, it has been, in most departments, very largely a matter of getting them set in the supply pipes somewhere, without any special regard to the advantages to be obtained in operation, repairing, testing and reading. The location of meters has varied almost as much as the types of meter boxes used, and the manner of setting. In the warmer climates it has been very largely the practice to set meters in the sidewalks. This has been varied, however, by setting them in the street or roadway, and in front yards or lawns. In some cases they have been set in cellars or within the premises served. In the colder climates it has been very largely the practice to set them in cellars or within the premises served. This practice has been varied to some extent, however, by setting them in sidewalks and front yards, within pits with heavy cast iron frames and covers.

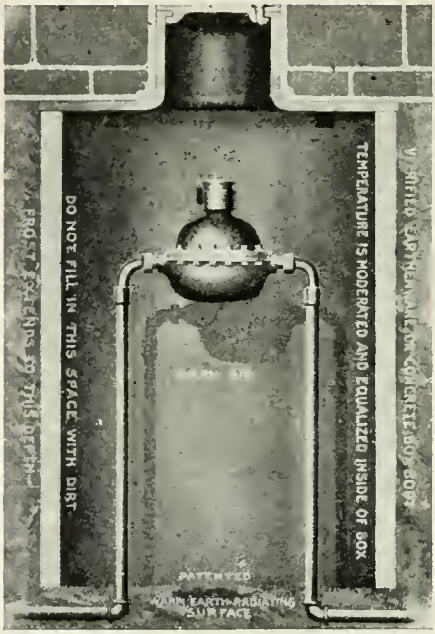
The following communication from Mr. Henry Newhall, superintendent Danvers water works, Danvers, Mass., contains an account of an interesting experiment with meter boxes:

"I was obliged in 1903 to put some of our large, from 2 to 6-inch meters, underground, and as we lost many from fire and frost, began considering placing them all so. The large ones I placed in brick or concrete pits to the full depth. This, of course, was too expensive for the smaller ones, and I experimented some until I became convinced that they could be placed much shallower and not freeze.

"I received from the H. W. Clark Co. their circular about covers, they using tile at that time for boxes. I had a sheet iron form made (afterwards getting form from them) and made a few boxes of concrete, and set meters as an experiment. I use two, 20 by 24-inch, giving a depth of 4 feet 4 inches with cover, and put the meter 20 inches to top of dial. I have never had one freeze, altho every one, including many meter works men, told me I would have no meters by spring.

"We have spells of practically zero weather running also from 10 to 20 below. We have had four winters in the past ten years when the frost has been

over five feet deep. Services, hydrants and dead ends of mains have frozen, but no meters. Our pipes have 4½ to 5 feet cover. In 1912 I had a meter close to the roadway on a sandy gravel. Six serv-


DO NOT FILL IN THIS SPACE WITH DIRT
TEMPERATURE IS MODERATED AND EQUALIZED INSIDE OF BOX
PATENTED
EARTH RADIATING SURFACE

SECTIONAL *view showing setting of Clark meter box and how freezing is prevented.*

ices within 300 feet froze. The frost went in 6 feet. This meter was 18 inches below the surface. I have tested this pit with thermometer standing below zero for several days and found it 40 above at height of dial.

"I have boxes on which both salt and fresh water stand all the time and have never seen any ice, altho the top and sides of the box may be frosted. I can conceive no way to make a meter freeze unless you make a water tight pit. If you leave the bottom open to receive the warm air from the earth it cannot freeze. My experience has been that boxes with dead air spaces on top are entirely necessary.

"We have had weekly periods of severe weather when the thermometer has registered from 4 degrees below zero to 15 degrees above, but in spite of such severe tests, temperature inside meter box has registered 38 degrees above. These tests were made by resetting the thermometer dial on the meter, the pipes of which were 16½ inches below cover, which was about level with the ground.

"Our experience with the Clark type of meter box has been so successful that I feel safe in stating that no freezing of meters will result when the space below the meter and to extreme depth of the box is left open, thus aiding in the heating up of the air from the radiating surface at the bottom.

"Meter boxes of this type possess decided advantages over the ordinary box and will, under ordinary circumstances, pay for themselves within two or three years in the saving of time and expense in removing meters for testing and repairing. Several types of these boxes are equipped with stop cock, which obviates the expense of providing a separate stock the expense of providing a separate stop cock box. In cases, however, where the stop cock and service box have already been installed in the pipe lines, it would probably be advisable to use a type of box without the stop cock, unless for the sake of standardization it might be deemed advisable to do away with the old stop cock and box, and install all services with stop cock inside the meter box. These are questions that would have to be determined by local conditions.

"The question as to plumbers having access to the stop cock would also have to enter into this, as, in many cities, the plumbers are not allowed access to the meter boxes at all. Local ordinances and rules, as well as local conditions, would also have some bearing as to the advisability of location of the stop cock in the meter boxes, for the reason that in many cities the water departments merely run the supply pipes up to the curb line, and the owner of the premises must furnish the stop cock and the service box. These practices vary to such an extent that it is almost impossible to outline any general plan that would meet all of these requirements. Wherever local conditions will permit, however, the stop cock should be installed within the meter box, and access to this box should be limited absoluetely to authorized employes of the water department."

Use of Small Mixer.

"Our experience has been that a small concrete mixer is most economical for small job," states Ernest McRoberts, Malta Bend, Mo., "and it also teaches us that a number of small mixers are economical in large jobs.

"Many contractors who use large mixers on large work adopt old hand-mixing methods on small jobs, but experiments conducted on the strength of machine concrete mixed for varying periods indicate that the materials must remain in agitation with the water for at least

a full minute. The tendency to rush the work is not productive of good concrete, and should consequently be curbed. In general, machine mixing where carefully controlled is superior to hand work, since fatigue of the workmen has no influence upon the thoroughness of mixing.

"Generally speaking, wet concrete will give better results than dry, and where possible, should be used. In sidewalk and curb and gutter work, enough water should be used so that it will just flush to the top under light tamping. For roadway construction, a similar concrete is generally used for the two-course work, but for the single-course construction a wetter mixture serves the purpose better.

"For the mortar top a medium or plastic consistency is recommended. A "soupy" mixture, sometimes used, is liable to produce a poorly bonded top, and besides causing very slow hardening, has a bad effect upon the cement itself. On the other hand, a dry mixture finishes poorly and is liable to show blotches. A correct mixture will just show water on top. after being "rodded" off several times with the straight edge or template.

"With the sub-grade or sub-base properly prepared and with good materials correctly proportioned and thoroly mixed, the assembling of these in a manner which will result in a permanent structure should not be neglected. The concrete should be deposited and tamped into final position within the forms on the sub-grade or sub-base, previously wet, as quickly as possible.

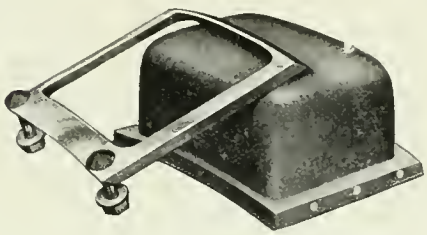
"We use a sixth-yard mixer taking two wheel barrows per batch, which is furnished us by the Jaeger Machine Co., Columbus, Ohio. This mixer weighs 1,500 pounds and has a daily capacity of 50 yards. This mixer being of medium size meets every demand of the contractor. It is not too large for the ordinary small job and yet a number of these machines on the large jobs can be operated a great deal more efficiently and economically to our way of thinking than a large mixer, requiring a large gang. Whenever too many workmen are placed in too close juxta position, some must always wait for some of the others to get out of the way. There is invariably more or less confusion and loss of time means a leakage in cost.

"This mixer is operated by 2½-h.p. Vandusen engine which can be operated by unskilled help. This mixer will turn 4 to 6 cubic feet per batch at a gasoline cost of from 3 to 4½ cents per hour. It is exceedingly simple in construction having but two discharge levers and three mixing plows in the drum.

On all medium sized jobs this type of mixer saves from $3.00 to $18.00 as compared with hand-mixing cost.

Tires for Fire Trucks

The Goodyear Tire & Rubber Company are marketing a type of individual-block fire-truck tire which is finding many warm friends among fire engineers, who claim that this type possesses many exceptional traction and non-skid features for rear wheel use on heavy apparatus. Should any one block become damaged, it can be replaced readily. Instead of having the whole tire repaired or replaced, a new block can be put on as needed from time to time, and a few blocks take the place of the extra tires usually carried. The chief advantage of the block tire is the individual feature. Each block on the Goodyear individual block tire has its own individual fastening. Thus to remove a block, it is not necessary to loosen the plate that holds a half dozen or more blocks.



SECTION *of block solid tire with frame for fastening to rim.*

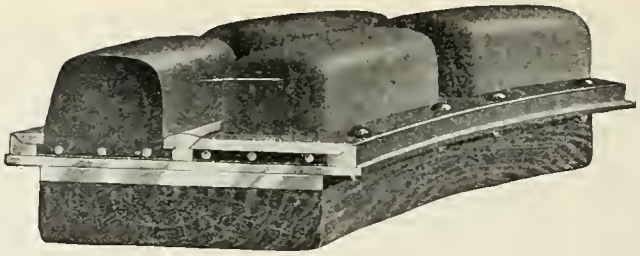
This individual fastening is in the form of a rectangular metal collar. It fits down over the base of the block. To remove the block, all attention required is but to lift the rectangular plate, and pull it from under the center ring under which it is wedged.

The Goodyear no-rim-cut non-skid tire is very popular for high-speed fire trucks, patrol wagons and ambulances where the gross weight does not exceed 10,000 pounds.

The Goodyear demountable cushion fire-truck tire has a notched dual tread, slantwise bridges, and undercut sides supported by slantwise bridges assure a resiliency almost equal to the pneumatic.

Jos. C. Millmann, secretary and treasurer Stegeman Motor Car Co., Milwaukee, Wis., makes the following report on Goodyear demountable cushion fire-truck tires as used on test of large Stegeman combination chemical and flying squadron wagon for the city of Milwaukee, October 31, 1912:

"The run was made from Milwaukee to Highland Park, Ill., and covered a distance of approximately 180 miles. Before we started back from Highland Park we had the good luck of riding in a steady



INDIVIDUAL *block tire fastened to rim.*

downpour of rain. The rain started about 10 o'clock in the morning and kept up the entire day.

"In going down we took the lake shore road, which has from 5 to 6 miles of very deep sand, the larger portion of which is not less than 6 to 8 inches deep. On our return we had to travel most of the distance on narrow country roads of poor soil with some mighty steep grades. While the test was very unusual and beyond anything the machine would be required to perform in the service, the large 6-cylinder motor did not seem to be taxed to its limit.

"We had expected to run into some difficulty on account of these poor roads, especially as we were not equipped with any anti-skid devices outside of the advantages claimed for Goodyear fire-truck tires. It was certainly a pleasant sensation to notice how these tires behaved under the conditions named. They proved themselves to be anti-skid, kept the road, and allowed us to keep up high speed. As we turned in the cities of Racine and Kenosha on the wet asphalt pavement we maintained a speed of 45 miles an hour, and took right-angle turns on the wet asphalt at a speed of 18 miles an hour without skidding. While we claim a certain amount of credit for the design of the Stegeman, in its low center of gravity and its distribution of the load over the rear wheels, we are frank to concede that the anti-skid features of the tires played a remarkable part in the test."

Motor Fire Apparatus in Manchester (N. H.)

By Charles F. Bowen.

The city of Manchester, N. H., put into service on October 1, 1910, a combination chemical and hose wagon, which cost $5,500. This was a 60-horse-power Knox machine weighing 7,750 pounds unloaded, and approximately 9,000 pounds when carrying men and equipment. The machine regularly carries 750 feet of 2½-inch water hose, 250 feet of ¾-inch canvas rubber chemical hose, one 35-gallon chemical tank, two 6-gallon chemical tanks, one 10 and one 20-foot ladder, the latter being an extension ladder, also the regular equipment of bars, plaster, hooks, axes, etc.

The company consists of a captain, lieutenant and six hose men, and is the only permanent one in the city. These are two chauffeurs, one of whom drives to still alarms and the other to bell alarms; but every man in the company does more or less of the driving, and one of the chauffeurs is changed every three or four months in order to carry out the idea. The wagon carries three signals—the regulation automobile horn, a fire bell with rope pull back of the driver's seat, and a siren whistle. The last named is not permitted on other vehicles, and is effective in clearing the streets thru the busiest section of the city. As this is the first piece of fire apparatus to reach a fire and is the only one which answers every alarm, the helmets of the chief and members of the board of fire engineers are carried on it. It is known as "Flying Squadron A."

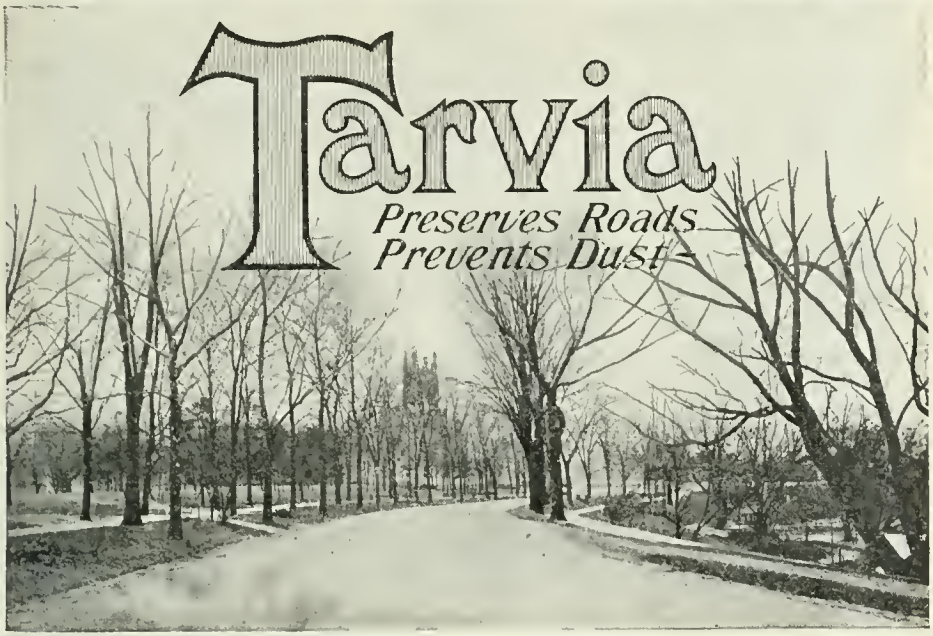
To indicate the extent of the service of this machine in a city like Manchester, with a population of over 70,000, the monthly running list is given herewith:

1910—October, 47; November, 21; December, 35.

1911—January, 41; February, 22; March, 25; April, 51; May, 36; June, 13; July, 39; August, 11; September, 20; October, 19; November, 16; December, 28.

1912—January, 62; February, 34; March, 31; April, 35; May, 37; June, 47; July, 34; August, 17; September, 13; October, 23; November, 22; December, 25.

It will be seen that the machine has been kept busy in winter time, but not so busy in summer time. As a matter of fact, however, in late summer a squad is continually out on brush and grass fires, sometimes startlng out early in the morning and staying untll late at night, all of which would be recorded simply as one run.



Wade Park, Cleveland, Ohio. Treated with "Tarvia A."

Cleveland's Experience with Tarvia

CLEVELAND'S experience with Tarvia has been very satisfactory. Tarvia has been used on the various roads in the parks and in the boulevard system. The following is taken from the Annual Report of the Department of Public Service.

"On the West Side, Edgewater Park and the Boulevard, the roads were treated two years ago with a surface coating of Tarvia and hence only needed a renewal coating of the same material with silica sand. This renewal cost was quite small and the results satisfactory. We would recommend a similar periodical recoating for the East Side roads about every other year.

"The results we have secured from the methods of resurfacing and repairing, as above set forth, are such that we hope the general plan may be continued on the park roads not already repaired. This form of construction offers a hard, resisting surface to traffic and thoroughly preserves the road, whereas in our opinion, the *normal disintegration of the macadam roads has heretofore been hastened by oiling.* The oil seems to be lacking in binding quality and tends to break up the macadam surface."

"Tarvia X" is a dense, viscid coal tar product of great cohesive and bonding power for pavement and road construction. "Tarvia A" and "Tarvia B" are lighter materials of the same nature for dust suppression and road preservation. "Tarvia X" and "Tarvia A" require heat for application. "Tarvia B" is applied cold. As a rule a tarviated road lasts so much longer than ordinary macadam that the cost of the Tarvia treatment is more than saved.

Booklets on Request.

BARRETT MANUFACTURING COMPANY

New York Chicago Philadelphia Boston St. Louis Kansas City Cleveland
Cincinnati Minneapolis Pittsburgh Seattle Birmingham
The Paterson Mfg. Co., Ltd.—Montreal Toronto, Winnipeg, Vancouver. St. John, Halifax, Sydney, N. S.

TRADE B MARK

Up to the first of this year the machine had made 1,000 runs, covering nearly 3,200 miles. It has never failed to complete a run to a fire or to be able to start out when in commission. The territory covered is about fifteen miles square, and the roads may be conservatively described as dreadful. It has been driven thru swamps in the country districts, over smoking tracts of hilly ground to get at brush fires, thru woods and narrow rural lanes and cluttered back streets, as well as the wide and smooth business thorofares. It has been driven wherever there was room to get thru without doing much damage to property, and its ability to run right up to the fire and get there promptly has been the greatest advantage and has created public confidence in the work of the squad. It is estimated that the squad, during the not quite three years, has performed work which a similar piece of apparatus, horse-drawn, would ordinarily require fifteen years for.

During this time two jack shafts have been broken, both as the machine was trying to start out of heavy sand into which the wheels had sunk. Once a cylinder went dry thru fault of a local adjuster. Tires have had to be changed before returning from a fire on two occasions, and six new tires have been purchased since the machine was put in service. The machine has been temporarily out of commission three times to permit of overhauling the motor, each requiring a day; twice for repairing the jack shaft, each time requiring four days; once for three days, while repairs were being made to the cylinder. While it was out of commission or when an alarm comes in while the auto is out answering another call, a two-horse chemical engine, equipped with two 60-gallon tanks, does this squad's work. But altho it is equipped with rubber tires and is drawn by fast animals, its work is not comparable with that of the motor.

There has been little tire trouble, and no extra tire is carried by the machine regularly, but when a call is made for a long distance, say five or six miles, an extra tire, already blown up, of which two are always kept at the station, is placed on the machine. Every puncture is immediately vulcanized by use of a Shaler electric vulcanizer, which is part of the station's equipment of the apparatus.

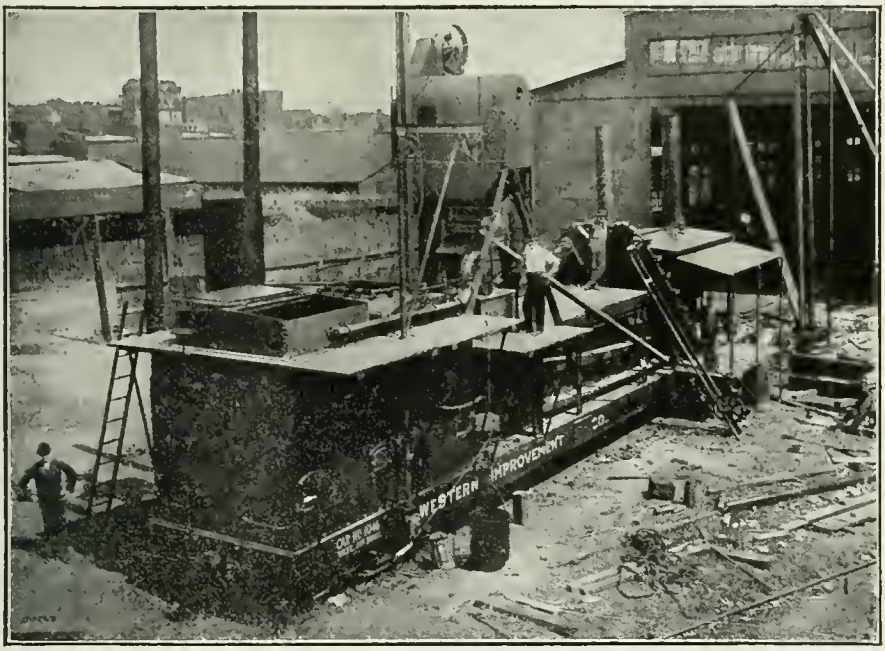
The machine can be gotten under way within ten or fifteen seconds from the time the alarm comes in. Members of the squad company answer the calls of the telephone, thereby saving one element of delay, when minutes may count up into hundreds of dollars. Illustrations of the time made are a four-mile run over an exceedingly heavy road in ten minutes and a six-mile run to a neighboring village over average country roads in thirteen minutes.

Coniform Chimney Construction

In designing a chimney the thickness of the outside shell must be sufficient to bear, with the steel imbedded in it, the pressure due to the weight of the chimney and to the wind. A proper number of vertical steel rods or bars must be inserted all around the chimney to resist the pull caused by wind pressure, and steel hoops must also be placed at intervals to stiffen the vertical steel and prevent cracks due to difference in temperature between the interior and exterior, and especially to resist the vertical shear which corresponds to the horizontal shear in a beam. It is customary to assume 50 pounds per square foot of vertical surface as a maximum wind pressure; this corresponds to a wind of 100 miles per hour. It can be proved mathematically that when wind blows against the curved surface, a part of it is ineffective, so that

METHOD *of constructing and reinforcing coniform chimney.*

MODEL OF 1912 ONE-CAR PLANT.



1,000 SQUARE YARDS 2-INCH TOPPING PER DAY.

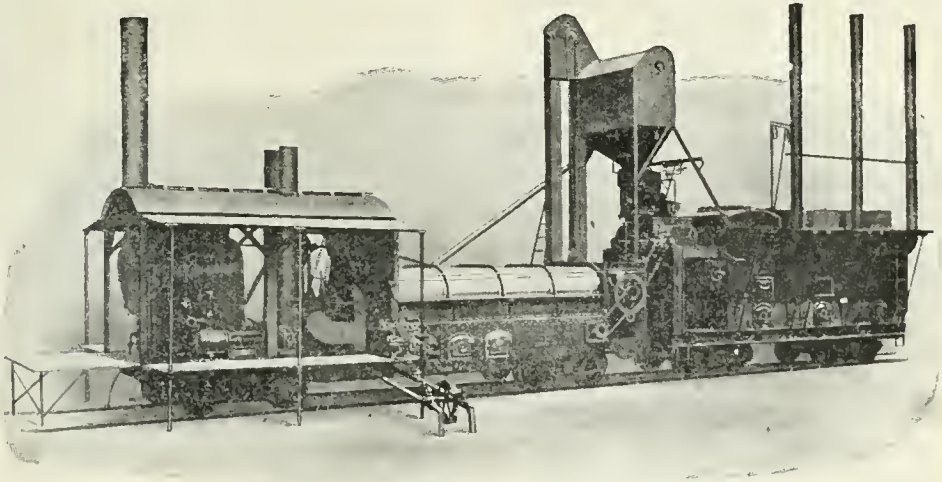
HETHERINGTON RAILWAY ASPHALT PAVING PLANTS

The product of 16 years experience in Plant Building by the originators of the first railway plant. **Still lead, are only safe railway plants made.**

THESE PLANTS HAVE NO EQUALS. WRITE FOR CIRCULARS.

HETHERINGTON & BERNER, - INDIANAPOLIS. IND.

1,500 SQUARE YARDS AND 2,000 SQUARE YARDS PER DAY.



MODEL OF 1912 TWO-CAR PLANT.

the effective pressure against the chimney is not more than two-thirds the normal pressure on a vertical plane surface whose width is the diameter of the chimney. Hence, 33 pounds per square foot may be taken for the pressure against this vertical plane. If the chimney is surrounded by buildings, this would of course act only above the roof.

In designing Weber coniform chimneys, a high factor of safety is allowed and low stresses are calculated on both steel and concrete, resulting in a very conservative design. The calculations used in designing Weber coniform chimneys are based on the formula of Turneaure & Maurer (F. E. Turneaure, dean of the College of Engineering, University of Wisconsin, and E. R. Maurer, professor of mechanics, University of Wisconsin), as published in "Principles of Reinforced Concrete Construction," second edition, page 398, who are considered the highest authority on this subject. The reinforcement of Weber chimneys consists of vertical bars encircled at regular intervals by steel rings properly bent to the required circle, weight and number of these bars being entirely dependent upon the dimensions of chimney, etc. Wherever the bars connect lengthwise, a proper overlapping is given; these joinings are made very irregular, preventing, so far as possible, many joints at one height. All the tensile stresses due to wind pressure, etc., are taken up by the vertical steel reinforcement. The resistance of the concrete itself against tension is not considered in our calculations. The horizontal rings are used for the purpose of taking up wind and temperature stresses.

The Destruction of Garbage on the Premises

By Francis A. Herring, C. E., Chicago.

In the minds of many, garbage means all household refuse materials. In fact, it is only the animal and vegetable matter, the refuse food from tables and kitchens, restaurants and butcher shops. The ashes and rubbish are collected and disposed of separately. We hear but little discussion of the latter two classes of household refuse. The prominence given garbage is due to the fact that after twenty-four hours it becomes obnoxious and a menace to health.

The city ordinances of Chicago provide that garbage shall be separated by the householder from the ashes and rubbish, and shall be kept in separate cans. Theoretically, this is done. As a matter of fact, the separation is not complete. Much of the garbage is put in the can with ashes and rubbish, and while the amount may not be noticeable in a particular case, the result of the practice can be noted in no uncertain way at the open dump for ashes and rubbish, especially on hot days. Moreover, the discarded materials from sick rooms often go into the rubbish cans and in that way disease may be spread.

It is perfectly obvious that enough garbage is delivered to the open dumps about a city to make them obnoxious and unsanitary and that some remedy must be supplied. Shall a more serious attempt be made to have the garbage separated from the other refuse? Or, if it is impossible to get a perfect separation and deliver all the garbage to the reduction plant, what can be done? Shall the present plant be continued to take care of such garbage as can be obtained unmixed with other material? And shall incinerating plants be erected thru which all the ashes and rubbish of the city shall be passed in order to destroy the garbage these materials contain? Or shall all the materials be delivered unmixed in one collection and disposed of once and for all by incineration? Also shall the collections be made by wagon, steam road, street railway or boat, or by some combination thereof, or maybe all four of these means be adopted?

The answers to these questions can be given intelligently only in the light of information as to the quantity, distribution and character of the materials to be collected and disposed of. No similar undertaking is attempted in the business world without determination of such essential facts. A railway or sewer, for instance, is not built without a survey to obtain data on which to base estimates of cost and the best methods of conducting the work.

The appropriation by the city for the collection, removal and final disposal of refuse of all classes, it appears, is sufficient for these purposes if properly expended. The cost of collection is, in most cases, too high. A reduction in appropriation, however, is not recommended, as all saving effected by closer supervision should go to the betterment of the service.

From the standpoint of one who has considered the garbage question thoroly, it appears that one possible solution has been overlooked almost entirely, and that is the elimination by burning of garbage and refuse on the premises where they originate.

One of the worst features of the garbage question is the fact that it must be hauled thru the city to a far distant reduction or incinerator plant. Not only are the garbage wagons unsightly, but the foul odors coming from them are offensive to citizens and are no doubt in many cases dangerous.

Fairy Magic—Telephone Reality

A tent large enough to shelter his vast army, yet so small that he could fold it in his hand, was the gift demanded by a certain sultan of India of his son, the prince who married the fairy Pari-Banou.

It was not difficult for the fairy to produce the tent. When it was stretched out, the sultan's army conveniently encamped under it and, as the army grew, the tent extended of its own accord.

A reality more wonderful than Prince Ahmed's magic tent is the Bell Telephone. It occupies but a few square inches of space on your desk or table, and yet extends over the entire country.

When you grasp it in your hand, it is as easily possible to talk a hundred or a thousand miles away as to the nearest town or city.

In the Bell System, 7,500,000 telephones are connected and work together to take care of the telephone needs of the people of this country.

As these needs grow, and as the number of telephone users increases, the system must inevitably expand. For the Bell System must always provide a service adequate to the demands of the people.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

Furthermore, from the standpoint of the home owner or the owner of the apartment building it would be wise to burn the garbage on the premises. We have too long been regarding garbage as of no value, while as a matter of fact the eagerness with which a great many reduction companies will make contracts is ample proof that garbage is of value.

Considered as fuel, engineers tell us that one ton of garbage contains as much heat giving matter as 200 pounds of coal. In other words, garbage is worth one-tenth the price of coal.

During the last few years several water heating garbage burners have been invented and these are giving satisfactory results in large and small apartment buildings, hospitals, hotels, restaurants, and in some of the larger homes. The purpose of all these devices is to make use of the garbage as fuel, water for domestic purposes being heated at the same time that the garbage is being destroyed.

Probably the garbage burner most worthy of mention is the one manufactured by the Kewanee Boiler Company, of Kewanee, Ill., and known as the Kewanee water heating garbage burner. This garbage burner is built of steel and contains a separate grate for holding the garbage and refuse. The particularly efficient part of this burner is the by-pass at the rear of the garbage chamber. This permits the fire to circulate around the moist and wet garbage, drying it to a point where it can easily be burned. There is, therefore, no possibility of the wet or moist garbage smothering the fire and the burner has proven to be not only the most sanitary method of disposing of garbage on the premises but the most economical method of heating water.

One No. 36 (type D) Kewanee water heating garbage burner as installed in a three-story, twelve-apartment building at the northwest corner of 65th and Ellis avenue, Chicago, subjected to 72 hours observation, produced the following result, showing that the cost of burning the garbage and supplying hot water to each apartment for 24 hours averaged 4 cents:

Total amount of coal used.....684 pounds
Total cost of coal.....$1.44
Total amount of water furnished.....
.....2790 gallons
Average temperature of water furnished .....155 degrees
Raised from average temperature of...
.....36 degrees..
Garbage burned.....20 bushels
Used Pocahontas coal, cost..$4.20 per ton

One No. 37 (type D) Kewanee water heating garbage burner as installed in a four-story, sixteen-apartment building, at 1047 East 47th street, Chicago, subjected to a 72-hour observation, produced the following result, showing that the cost of burning the garbage and supplying hot water to each apartment for 24 hours averaged 2.9 cents:

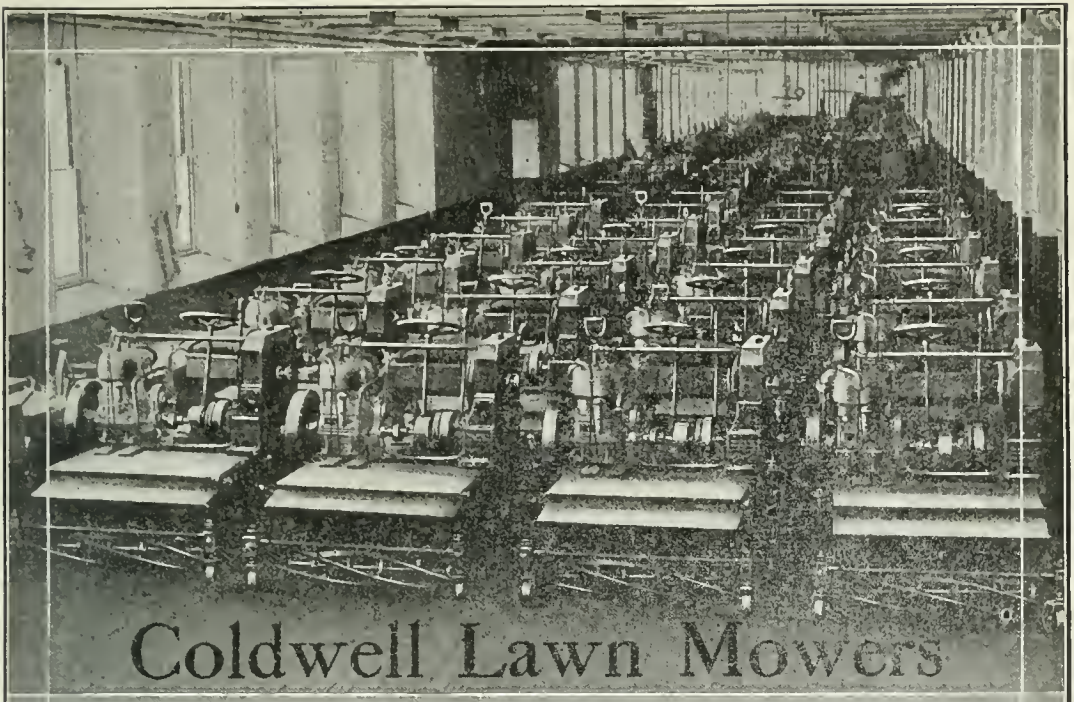
Total amount of coal used....681 pounds
Total cost of coal fired.....$1.43
Total amount of water furnished.....
.....4659 gallons
Average temperature of water used....
.....143 degrees
Raised from average temperature of...
.....36 degrees
Garbage burned.....15 bushels
Used Pocahontas coal, cost..$4.20 per ton

One No. 39 (type D) Kewanee water heating garbage burner as installed in a twenty-eight-apartment building, each apartment containing ten rooms, 280 rooms in all, at Kenmore and Lawrence avenues, subjected to one week's observation, produced the following result, showing that the cost of burning the garbage and supplying hot water to each apartment for 24 hours averaged 1.64 cents:

Total amount of coal used....219 pounds
Cost of coal used.....46 cents
Garbage burned.....33.6 bushels
Pocahontas coal used, cost..$4.20 per ton

Were an ordinance contemplated which would necessitate the installation of a device for burning the garbage by incineration on the premises where it originates, it is undoubtedly true that a storm of protest would be raised by owners of apartment buildings, hospitals, hotels, restaurants, etc., due to lack of knowledge of the value of garbage as fuel. As a matter of fact, such an ordinance would not be a hardship on anyone, but would rather be the means of saving for the apartment owner, the restaurant, hotel, hospital, etc., a sum of money from what he is now paying for the hauling away of the garbage and the heating of hot water for domestic purposes. The figures cited and these figures are fair in every sense of the word, prove this beyond any reasonable doubt. It is impossible to provide hot water at a cost anywhere near as low as the average cited where fuel for the heating of this water must be purchased. The only way this is possible is to make use of the garbage and refuse for fuel.

In other words, the passing of an ordinance demanding the installation of a satisfactory garbage burner in every building where a number of people are housed, would first eliminate entirely the garbage question by absolutely destroying the garbage on the premises before it has an opportunity of becoming obnoxious, and second, would be the means of effecting a noteworthy economy for the owner of the building in reducing the cost of his hot water supply.



Coldwell
1855

California
1915

In 1855 Thomas Coldwell built the first Lawn Mower ever made in America. The Coldwell Company has been building Lawn Mowers—better and better—ever since. That is why

Coldwell Lawn Mowers

Hand, Horse and Motor—are to be used exclusively on the grounds of the Panama-Pacific Exposition, at San Francisco, in 1915.

The managers of this great exposition wish to show the world the best that America can produce in every line.

In the Lawn Mower line they chose Coldwell from all the rest.

So, in previous years, did the managers of the Big Fairs in Chicago, St. Louis, Buffalo and elsewhere.

No other Lawn Mower on the market has ever received such high and consistent endorsement.

"Always use the BEST. The BEST is the cheapest. Coldwell Lawn Mowers are the BEST."

Made in 150 different styles and sizes to suit every need. Ask about our patent Demountable Cutters for Horse and Hand Mowers. Full Description on request, with free booklet on the practical Care of Lawns. Write today.

COLDWELL LAWN MOWER COMPANY

Philadelphia **Newburgh, N. Y.** **Chicago**

Trade Notes

The new Equitable Life Insurance building in New York, thirty-eight stories high, will contain approximately 36,000 tons of structural steel, the inspection of which, both mill and shop, has been intrusted to Robert W. Hunt & Co.

The MacArthur Concrete Pile & Foundation Co., 11 Pine street, New York, have contract covering the foundation of the new retort house and other buildings to be erected for the Mohawk Gas Co., Schenectady, N. Y., to have about 550 pedestal concrete piles. They recently completed the pile foundation for a 2,000,000 cubic foot holder. They also have a contract for the concrete pile foundations of the new Hartford, Conn., Electric Light Co. office building.

The Martin Tractor Co., of Springfield, Mass., has been incorporated with a capital stock of $350,000. C. H. Martin, vice president and general manager.

E. L. Bloomberg has been put in charge of the new branch office of the Master Builders' Company, of Cleveland, O. It is at 705 Merchants Bank building, Indianapolis, Ind.

Erie Manufacturing & Supply Company, Erie, Pa., sales agents in that locality for the Dodge Manufacturing Company, has contracted with the city for bucket elevators and screw conveyors for handling ashes from the garbage burners in the city garbage plant at Belle Valley.

The Fred Medart Manufacturing Co., makers of playground apparatus in St. Louis, Mo., whose new factory and office were partly burned in June, are now at work in their new factory and able to take care of all orders.

The Dodge Manufacturing Company, New York City, has arranged with the municipal government of that city for a 50-h.p. rope drive in the New York Geological Park. This drive will connect an oil engine with a lineshaft driving refrigerating machines and generators in the public service building. The specifications call for two 72-inch and 36-inch iron sheaves of 7 grooves each, line shafting, clutches, pulleys, hangers and self-oiling bearings. Three hundred and seventy-five feet of Dodge Firmus Manila transmission rope will be used on the drive.

D. B. Luten, Indianapolis, has received his nineteenth decree sustaining his patents on reinforced concrete arches in his suit against Boyer, Patterson & Morris at Parkersburg, W. Va.

Ceresit, manufactured by the Ceresit Waterproofing Co., 446 Commercial National Bank, Chicago, Ill., has been awarded the Grand Prix at the World's Fair, held this year at Ghent, Belgium.

Trade Publications

"A Test by Technologists" is a booklet giving expert reports on the six years of weather tests of paint for steel on the Pennsylvania railroad bridge at Havre de Grace, Md., issued by the Lowe Brothers Company, Dayton, O.

Rock, ore and gravel handling machines are fully illustrated and described in Catalog No. 252 of the T. L. Smith Co., Milwaukee, Wis. The newest things in it are the double roller chain, return track elevator and the Telsmith portable bins.

The Duryea Motor Co., Saginaw, Mich., issues a 32-page booklet crowded with "what others say" about their motors.

The circulars of the Waterloo Cement Machinery Corporation, Waterloo, Iowa, concerning their "little wonder Five" concrete mixer are very striking and convincing.

A circular of the Trussed Concrete Steel Co., Detroit, Mich., describes their new seven-rib Hy-rib in sheets 24 inches wide with ribs ⅛ inch deeper than four-rib Hyrib, giving greater stiffness and permitting wider spacing of supports.

The Orenstein-Arthur Koppel Co., Koppel, Pa., have published a detailed and illustrated description of the use of their bucket ladder excavators on the excavation of the Spanish canal from Sevilla to the Atlantic ocean.

"Everything for Blue Printing," issued by the C. F. Pease Co., 166 West Adams street, Chicago, Ill., is the only catalog issued which is devoted exclusively to this line. It fills 64 pages full.

The Pittsburg Testing Laboratory, Seventh and Bedford avenues, Pittsburg, Pa., will send, on request, a valuable booklet containing the standard specifications for portland cement, adopted by the American Society for Testing Materials; the method for testing cement of the American Society of Civil Engineers; the standard specifications for concrete reinforcement bars rolled from billets, adopted by the Association of American Steel Manufacturers; and the specifications for concrete of the Pittsburg Testing Laboratory.

The "Pedestal Pile" is a 64-page book for engineers, architects, owners and contractors, describing the pedestal concrete pile and discussing the relative merits of wooden and concrete piles of various types. It is issued by the MacArthur Concrete Pile and Foundation Co., of New York, Philadelphia and Chicago.

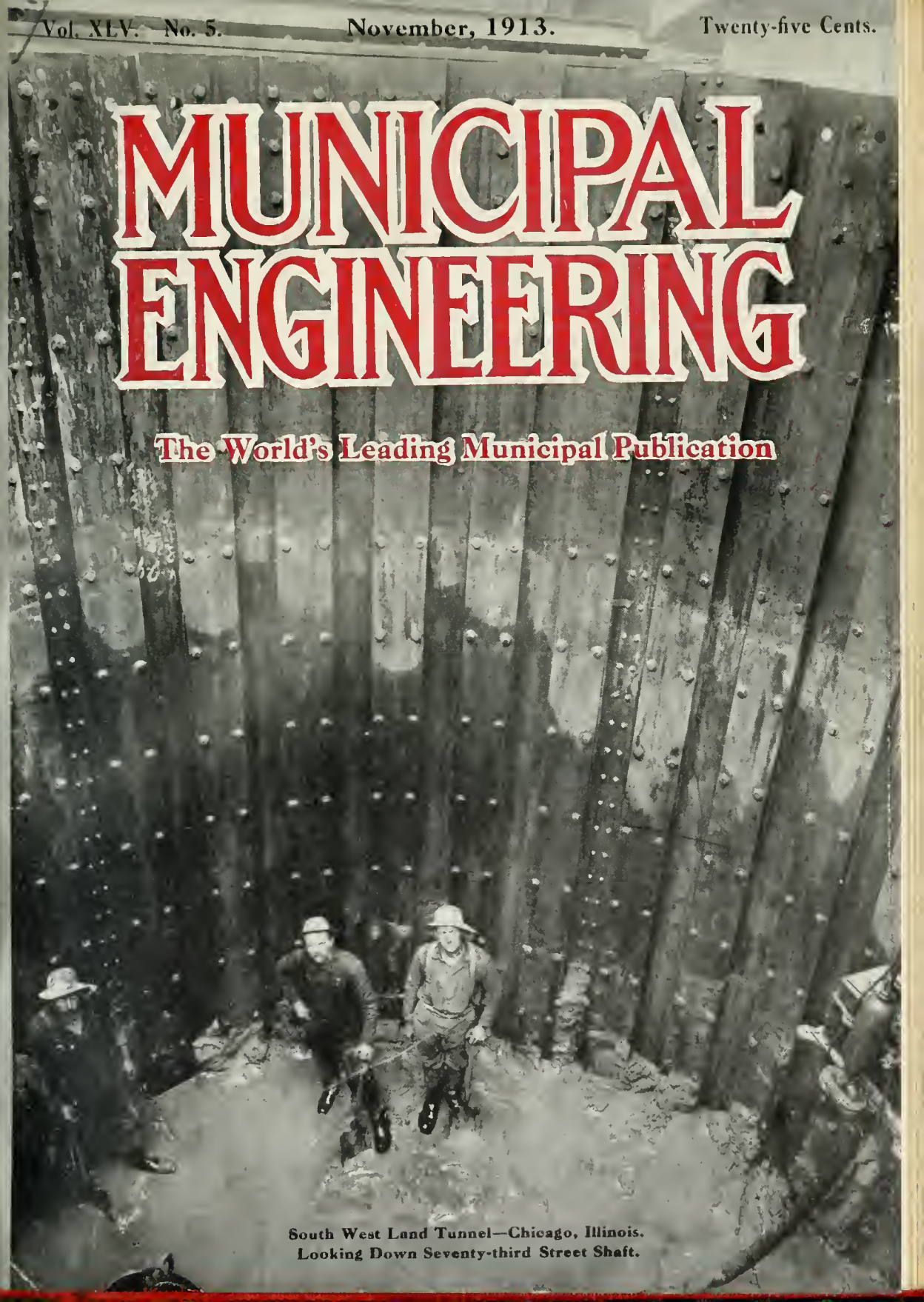
The Rockford railway motor cars are illustrated and described in Catalog No. 43 of the Chicago Pneumatic Tool Co., Chicago, Ill., and Bulletin 34R is devoted to Chicago pneumatic compressors.

"The Mixer" is a periodical reminder of the Koehring Machine Co., Milwaukee, Wis., that they make concrete mixers.

Vol. XLV. No. 5. November, 1913. Twenty-five Cents.

MUNICIPAL ENGINEERING

The World's Leading Municipal Publication



South West Land Tunnel—Chicago, Illinois.
Looking Down Seventy-third Street Shaft.

NOV 10 1913

Fraud—Dishonest Methods —Stolen Elections —Crookedness

Watch the newspapers following the November elections for "scare" heads announcing dishonesty, fraud, and all the 57 varieties of crookedness so often attributed to the successful party after any election. Such statements can not help but start the new administration out under a serious handicap, and while it is difficult to prove such charges, it is likewise difficult to disprove them, especially under the old time election methods where human error plays its important part. Many an honest official has been compelled to submit to such unjust criticism while powerless to defend himself with positive proofs of his innocence. The time has passed when the honest official need be subjected to criticism of this sort or when the dishonest candidate can successfully win an election by fraud. The modern election is governed by modern accuracy and infallibility with

A Triumph Voting Machine on the Job

¶ The Triumph Voting Machine deals with impartiality and justice alike with the crook and the honest candidate. It records the true vote and choice of the public. Its accuracy and security puts any election beyond the pale of subsequent criticism.

¶ Don't take chances. Don't trust to luck. Safeguard your ballot as you would your cash drawer. Don't risk the welfare of the public's interest to methods you would not permit in your private business.

¶ The **Triumph** protects each voter in enabling him to cast his ballot with absolute *secrecy*.

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¶ The **Triumph** is accurate. It can not fail to record each vote exactly as cast.

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47

MUNICIPAL ENGINEERING

The World's Leading Municipal Publication.

LARGEST *Bascule Bridge in the World—4,800 feet long. Over Willamette River, Portland, Ore.*

VOL. XLV. NOVEMBER, 1913. No. 5.

City governments are becoming more efficient each year. Progressive cities are calling on experts, who have spent years studying the efficient ways for cities and towns to administer their affairs, to come to them and investigate their problems and give them advice. Men are being employed by cities to act as general managers, commissions are studying the methods of large private corporations, and as a result are adopting ideas evolved by men and organizations who have been paid hundreds of thousands of dollars for what they know. MUNICIPAL ENGINEERING *will keep you alive to the important development in this great field.*

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CONCRETE ROADS

A Careful Inspection of Various Concrete Roads Brings to Light Both Favorable and Unfavorable Data.

An Article Based Upon Two Separate Reports.

TWO reports upon the Wayne county, Michigan, and other concrete roads have been prepared recently, based on data obtained thru careful inspections of the roads.

One of these reports is in the form of a paper by Frank F. Rogers, state highway commissioner of Michigan, before the American Road Congress, and shows the results of a careful and minute inspection of each road early in September, 1913, the first of a series of such inspections which will be made at intervals to determine the action of this road material. The second is a report by P. E. Green, M. Am. Soc. C. E., made for the village of Highland Park, Ill., upon the question of the availability of this form of road construction for the streets of that municipality. His inspection was less minute but the general result is practically the same, therefore Mr. Rogers' report is used herewith as representing the results of both inspections, occasional remarks based on Mr. Green's report being interpolated.

The accompanying photographs accompany Mr. Green's report and show in general the characteristics described in Mr. Rogers' report.

The first mile of Woodward avenue was built in May and June, and opened to traffic in July of 1909, thus giving it full four years of wear. The traffic record of this road shows a daily average of 2,160 vehicles, of which 88.1 per cent. were motor driven.

The soil is clay loam, inclining a little more to sand at the northerly end. A double track electric railway occupies the westerly side of the street. Between the railway and the concrete roadway is a very shallow gutter under which was laid a tile drain from 2 to 3 feet in depth. On the opposite side is an open ditch, the bottom of which is from 2 to 4 feet below the crown of the roadway.

The pavement is 18 feet wide, has a crown of 3 inches and a blind curb 8 inches wide and 4 inches deep under the outer edges which were somewhat beveled. The concrete was composed of portland cement, crushed field stone or cobbles and sand mixed in the proportion of $1:2\frac{1}{2}:5$ for the base which was 4 inches thick. The top layer was made of the same materials, using a 1:2:3 mix and was $2\frac{1}{2}$ inches thick.

No very definite data can be secured to determine the wear, which seems to be slightly greater on the side opposite the railway, but measuring from some of the harder pieces of the coarse aggregate which have been worn but little, if any, we have estimated the general wear at about $\frac{1}{4}$ inch, which would be an average of 1/16 inch per year.

This mile was divided into sections of about 25 feet, separated by expansion joints, there being 209 sections to the mile. The most of the sections were separated by four thicknesses of tar paper separated by thin boards which it was planned to remove as the work progressed, tho many of the boards are still in the pavement. Four of the joints were protected by pairs of steel angle bars, separated with tar paper and placed with one leg of each angle back to back so that the other leg of each bar was

flush with the surface of the concrete, thus covering a space of about 4½ inches at the joints. The concrete wears slowly on each side of the angles, leaving a raised joint that is slightly noticeable when driving over the pavement. This

REPAIR *gang repairing River Road with tar in* 1913. *This gang of seven men, with outfit, costs* $21.75 *per day, not including fuel for heating tar.*

was an experiment which has not been repeated.

Of the 209 sections constituting the first mile on Woodward avenue, 80 showed longitudinal cracks, 32 transverse cracks and 2 diagonal cracks while 46 sections were recorded as having holes, making a total of 160 sections which are more or less imperfect, or 76.5 per cent. of the entire mile.

The remaining portion of Woodward avenue, 252 sections, was built in 1910 using the same materials and the same mix. No blind curb was used and the crown was reduced to 2 inches. The soil on this section is considerably more sandy, especially toward the north end.

On this portion of Woodward avenue, 29 sections have longitudinal, 22 sections transverse, and 6 sections diagonal cracks and 11 sections have holes, making a total of 68 defective sections or 27 per cent. as compared with 76 per cent. in the first mile.

Mr. Green considers this a good road in good condition.

On Gratiot avenue in the season of 1910, 9,000 feet of 16-ft. concrete roadway was built. On this pavement gravel and sand were used for the aggregate and a one layer concrete having a 1:2:4 mix was laid. The soil is a clay loam and rather heavy. This road was not completed until late in the season and was opened to travel in November. It immediately pitted and looked rough and has been covered with a surface treatment of refined tar and fine gravel. It was re-covered this season, using a rather light grade of tar (Tarvia A) but it already shows some tendency to scale off. The experience in some other places leads the Commission to believe that a heavier grade of tar gives better results.

On the Grand River road 61 sections of two course concrete, the same as laid in the first mile of Woodward avenue, were built in 1909. The soil is a clay loam. The records show 11 longitudinal cracks, 2 transverse cracks, 1 diagonal crack and 3 holes, a total of 17 defective slabs or 27.9 per cent. The traffic count showed 1064 vehicles, 56.5 per cent. of which were motor cars.

In 1910 341 more sections were added to Grand River avenue under contract, the specifications being the same as for the north end of Woodward avenue. Thirty-three of these slabs became more or less pitted, some having quite large holes. They have been repaired by covering with refined tar and stone chips so

FAULTY *concrete well repaired. 1911 section Grand River Road. Many hundreds of small holes must be repaired each year with tar and sand.*

Beyond this portion of the roadway 326 sections of the same width concrete were laid in 1911 reaching to the county line. Washed pebbles and sand were used for the aggregate in a 1:1½:3 mix, one course concrete 7 inches deep being laid. The records for this piece are as follows: Longitudinal cracks, 11; transverse cracks, 10; diagonal cracks, 3; holes, 6; showing a total of only 30 defective slabs or 9.2 per cent. The traffic count on this road, taken at the county line, shows 507 vehicles daily, 65.8 per cent. of which are motor driven.

Mr. Green considers this road a failure protected from complete disintegration by the tar treatments.

that no defects could be observed at the time of the count, hence only 308 are shown in the table. The defects noted are as follows: 59 longitudinal, 20 transverse, 29 diagonal cracks and 46 holes, a total of 154 defective slabs or 50 per cent.

In 1911, 515 additional sections of one course concrete were placed on the Grand River road. Washed pebbles and sand were used for the aggregate with a 1:1½:3 mix. The Baker steel joint was used in all of this work except the first six sections. The defects noted are as follows: Longitudinal cracks, 8; transverse, 26; diagonal, 3; and holes 5, making a total of 42 defective sections or 8.2 per cent.

In 1912, 1,208 more sections were added

to Grand River avenue reaching to the line between Wayne and Oakland counties. The count on these sections shows as follows: 66 longitudinal cracks, 37 transverse cracks, 6 diagonal cracks and 5 holes, making a total of 114 defective sections or 9.4 per cent. The soil grew more sandy as the road extended westerly, considerable stretches being almost free from clay or loam.

Mr. Green considers this road to be not so good as Woodward avenue tho it has fewer cracks. Some of his remarks are given in explanation of the photographs.

¶ MICHIGAN AVENUE *will require careful maintenance to prevent disintegration.*

On Michigan avenue 481 sections of concrete, 17-ft. 8-in. wide were laid, using washed pebbles and sand for the aggregate in a 1:2:4 mix. The soil for the most part is a sandy loam, but a little heavy. The count shows as follows: 219 longitudinal cracks, 48 transverse cracks, 23 diagonal cracks, 21 holes, making a total of 311 defective sections or 64.6 per cent. The traffic count shows 1009 vehicles, 67.5 per cent. of which were motor driven.

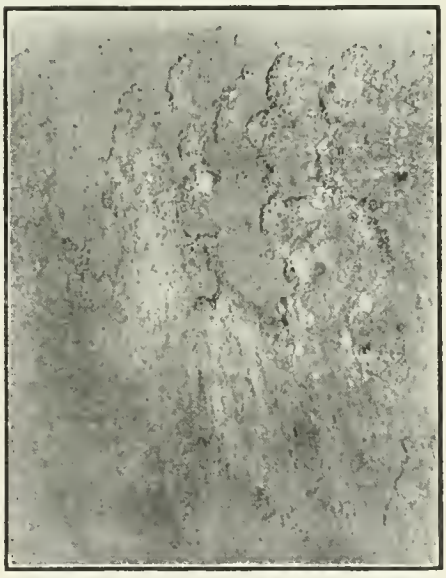
Mr. Green thinks this section would go to pieces in two or three years more if not carefully maintained.

In 1911, 1570 sections were added to this piece of road, using washed pebbles and sand for aggregate and a 1:1½:3 mix. The soil over which this pavement was laid is a sandy loam running into light sand at the west end. The count shows the following: 219 longitudinal cracks, 80 transverse cracks, 42 diagonal cracks, 14 holes, making a total of 355 defective sections, or 22.6 per cent. In 1912 this road was paved to within 1¼ miles of the county line, and this year completed to the county line, but no record was taken farther west than the east limits of the village of Wayne.

All observers unite in considering this section a fine example of a good concrete road.

In 1910, 149 sections of concrete 15-ft. wide and 6½ inches deep were laid on the River road, using gravel and sand for the aggregate and a 1:2:4 mix. The soil over which this road runs is for the most part heavy clay. The count shows as follows: 49 longitudinal cracks, 5 transverse cracks, 6 diagonal cracks and 2 holes, making a total of 62 defective sections or 41.6 per cent. The traffic count shows 538 vehicles daily, of which 78.9 per cent. were motor driven.

In 1911, 434 sections were added to this road some distance below the village of Trenton. The pavement was 15 ft. wide,



SURFACE *of Fort Road, 1910 section. Tar badly scaled.*

7 inches thick, built of washed pebbles and sand for the aggregate, using a 1:1½:3 mix. The count for this stretch of road shows as follows: 165 longitudinal cracks, 17 transverse cracks, 13 diagonal cracks and no holes, a total of 195 defective sections or 44.9 per cent.

In 1912, the gap between this piece of road and the southerly limits of the village of Trenton was closed in with a similar pavement to that just described, comprising 213 sections. The count on this piece shows defects as follows: 14

longitudinal cracks, 8 transverse cracks, 4 diagonal cracks and no holes, making a total of 26 sections or 12.2 per cent.

The same year there was added to the south end of the work done in 1911 something over two miles of concrete roadway, but of this only 208 sections were counted. Of the sections counted, 17 show longitudinal cracks, 9 transverse cracks, no diagonal cracks and no holes, a total of 21 defective sections or approximately 10 per cent. The soil of the entire road was heavy clay.

Mr. Green reports considerable wear and many small holes in the earlier sections of this pavement, in addition to the cracks. The latest section he considers excellent. One of the photographs shows a crack under repair for the second time.

In 1910, one-half mile of gravel concrete of a 1:2:4 mix, 12 ft. wide and 6½ inches deep was built on Fort street. This concrete like that already referred to on Gratiot avenue was built rather late in the season and was opened to traffic in November. It immediately pitted to such an extent that it has since been coated with refined tar and fine washed gravel, about ¼ inch in size. This covering makes an excellent surface and wears fairly well. Of course it was impossible to observe any further defects in the concrete at this time. Continuing south, in 1912 450 sections of concrete 12 ft. wide and 7 inches deep, and of 1:1½:3 mix were added. The count on this piece of road follows: Longitudinal cracks, none, altho another observer has reported there are 2; transverse cracks, 19; diagonal cracks, 9, and holes, 1. Total defective sections, 29, or 6.5 per cent.

Mr. Green seems to consider the 1910 section as one of the worst sections he saw, and the 1912 section the best. The concrete in the 1910 section he reports to look more like plain macadam in some places, and one of the photographs shows the scaling from the surface of the tar with which it has been surfaced in making repairs.

Mr. Green reports on two roads not included in Mr. Rogers' paper. The Mack road is 15 feet wide. The section built in 1910, 1,600 feet long, is one 6-inch course of 1:2:4 sand and gravel concrete, and cost $1.347 a square yard. It is in very bad condition, was surfaced with bitumen in 1912, but that is practically all gone, as one of the photographs shows. It has fairly heavy traffic with much teaming. The section built in 1911, 1,400 feet long, is one 7-inch course of 1:1½:3 washed sand and gravel concrete, and cost $1.75 a square yard. This section is beginning to wear in ruts from heavy hauling to Lozier automobile plant.

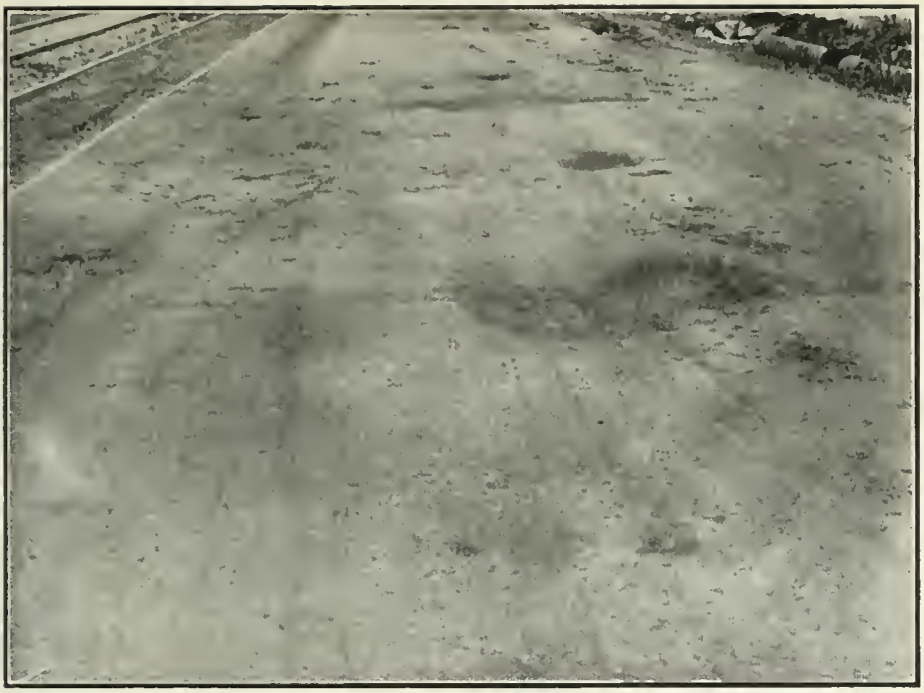
¶ MT. ELLIOT *Road in good condition, parts of it being an excellent example of concrete roadway.*

Mt. Elliot road, 12 feet wide and 4,000 feet long, built in 1910, is in 2 courses, one of 4 inches of 1:2½:5 sand and limestone and one of 2 inches of 1:3, and cost $1.44 a square yard. The surface is good, but 19 cracks in the length, nearly all longitudinal. Considerable patching has been done with tar and sand at joints and on sides. Lack of longitudinal cracks is attributed to narrow width. Traffic is fairly heavy hauling to railroad yards. The section, 18 feet wide and 2,400 feet long, built in 1911, is one course of 1:1½:3 screened sand and pebble concrete and cost $1.65 a square yard. The surface is good and only 13 slabs had cracks, all transverse, which have been repaired. There is considerable heavy hauling and the road is in good condition. The section, about 1,000 feet long, built in 1912, is in good condition and a fine piece of road.

Mr. Green's report includes also observations upon streets in Highland Park village adjacent to Detroit, and Windsor, Ont., which are far less satisfactory.

A comparison of the conclusions drawn by the two engineers will be interesting in view of the general agreement upon the facts in the case, Mr. Rogers' report of facts being more severe upon the roads, if anything, than is Mr. Green's.

Mr. Rogers notes that the longitudinal cracks almost invariably appear on fills and in cuts and in groups, indicating that local conditions cause them. He attributes them largely to settlement in



MACK ROAD *in* 1913, *village of St. Clair Heights, Wayne County, Michigan. Resurfaced with a bituminous surface in* 1912.

fills and to water and frost in the subgrade in cuts, and shows conflicting evidence on the proposition that a width greater than 12 feet invites cracks unless the pavement is thickened to correspond, the preponderance on Wayne County roads being against the claim. Holes are attributed to foreign matters in the concrete and inferior stone. He considers the pitted condition of the roads to be the most serious defect and to require the most constant attention for maintenance. These defects are due to defective materials and methods in building roads and not to the concrete principle itself, and he therefore considers that Wayne County has made no mistake in choosing concrete as a paving material for its main roads.

It may be added that the better condition of the roads of later construction seems, up to this time, to be due quite as much to better materials and methods as to shorter time of subjection to wear and elements.

Mr. Green agrees very well with Mr. Rogers regarding the use of concrete on county roads, tho he limits its use even then to traffic less than 250 vehicles a day, probably not including automobiles. In the light of the Wayne county experience this limit seems rather low.

Village and city streets being the field covered by Mr. Green's report, he considers the cracks, a proportion of which seem to be unavoidable, to be detrimental to property on account of their appearance. Breaks in the surface cause raveling and these occur with such frequency, in his observation, that they damage both by appearance and by rapid disintegration after the start is made, tho so long as no break starts the surface remains smooth and perfect.

A very careful estimate of the cost of maintenance is made by Mr. Green, based on his observation of the Wayne County roads. He computes the amount of sand and tar necessary to fill cracks, joints and holes of length and size observed and makes other more general estimates which produce a total estimated cost of

maintenance in 1912 and 1913 of $9,051.22. If the whole mileage is considered, this averages nearly $140 a mile for the two years, or $70 a mile per year. The data on which this estimate is based are not exact and some of the estimates are general acts of judgment so that it will be necessary to await further reports, especially the one for 1913, before accepting these estimates as very close approximations to the truth. It is evident that the cost of the experiments made in surfacing concrete with tar and sand should be considered largely as a maintenance charge, and care should be taken to include all expenses which belong to repair, including a proper proportion of the overhead charges. The reports of the Wayne County commissioners are quite full and their assignment of charges to construction, reconstruction, maintenance, repair and experimental work can be checked up readily. The report for 1913 will be read with interest, for it is evident that this is the first year in which maintenance charges have been large enough to be taken into serious consideration, except some resurfacing of roads with bitumen, the cost of which is charged in the reports to improved construction when it should be charged to maintenance and repair.

Civic Center for Boise, Idaho.

A general plan for a civic center for Boise, the capital of the state of Idaho, has been proposed by J. B. Marcellus, assistant city engineer, which avails itself of existing buildings and open spaces and of buildings proposed for early erection in a very ingenious manner, so as to reduce the extra expense of the strictly ornamental features to a minimum and interfere with no existing building which can remain in its present condition for an appreciable time.

The center of the plan is an area two blocks square, half of which is now occupied by the state capitol and its grounds. The postoffice now stands in one quarter and it is proposed to build a new court house in the other corner. By parking the entire four blocks a handsome setting for three good public buildings is obtained. The United States government needs area for extensions of the postoffice and the sale of the present court house site and its inadequate and dilapidated building will furnish funds to purchase the new court house square.

At one side of the state capitol is Columbian park. It is proposed to sell the present city hall and site, which is rapidly being outgrown and to use the money in buying a half block between the park and the city library, thus putting these two buildings into a park with an area of two blocks bordering the four-block central civic center for one-half its length.

In the blocks filling the two reentrant angles of the two parts of the civic center area are several semi-public buildings, such as churches, G. A. R. and Elks' halls and theater, and other churches border Columbian park. Locations for proposed new buildings, such as K. of P., Masonic and Odd Fellows' halls, fill the spaces as yet unoccupied or covered with inexpensive and comparatively unsightly buildings.

Boise real estate is as yet cheap enough to make such a plan as this possible at no extra cost, but if there is delay in proceeding toward the acquirement of the necessary land, business developments with their new buildings and necessities fixing elsewhere location of some of the semi-public buildings now in contemplation, will put insuperable obstacles in the way.

Not all the construction proposed will be carried thru at once, but the lands can be acquired or definitely set aside so that the plan in general can be carried out within a few years. It is seldom that a capital city has so favorable an opportunity to beautify itself without extra cost.

WATER STERILIZATION BY ULTRA-VIOLET RAYS

A Process which Eliminates the Necessity of Adding Chemicals in Order to Purify Water. Sterilization is Produced by a Machine Making Use of the Actinic Rays in Light.

By James A. Seager, Bristol, England.

THE purification of drinking supplies is becoming so thoroly well recognized as a necessity in modern urban existence that very little need be said to urge the importance of a consideration of the subject. Reference may at once be made, therefore, to what is probably the newest form of water purification in existence, and one which appears to be giving some most remarkable results. This is the sterilization of water by means of ultra-violet rays. In this treatment the water is made to flow past a source of ultra-violet rays, this source being a mercury vapor lamp. The water is not in contact with the burner, but is made to flow very close to it, and a number of baffle plates are arranged in such a way as to make the water pass several times under the influence of the ultra-violet rays. In this way a sufficiently long exposure is given to cause the destruction of all the microbes contained in the water.

Sterilization in this way can be effected either by a bulk process such as would be adaptable to main water supplies, or by treatment for each household in a somewhat similar way to that in which water is filtered by the older process after emerging from the tap. It may perhaps be advisable to study the subject from the latter point of view first, in order to obtain a definite idea as to the construction of the apparatus.

Fig. 1 shows diagrammatically the arrangement of a small unit apparatus of this description. It consists of a cylindrical enameled tank 12 inches in diameter and 20 inches high, and weighing 24 pounds, which is equipped with two drain taps RR, terminals, marked + and — to indicate their polarity, fitted in the cover of the tank, and a tilting device for starting the lamp. This has a 110-volt quartz mercury vapor burner controlled by means of an electric switch. In series with the switch is a rheostat regulating the tension of the current, and a 110-volt electric bell is so connected as to ring whenever the current is switched on and the burner is for any reason put out of circuit, ceasing to give its ultra-violet rays.

The sterilizer is mounted on a cast-iron bracket and has an output which varies with the quality of the water treated. For example, with water which is perfectly colorless and transparent, an output of 130 gallons per hour can be obtained. This is the normal result in large towns, but in some cases the water to be sterilized is colored or contains finely divided solid matter in suspension. In such cases it is advisable to subject the water to a filtering process or to reduce the rate of sterilization. The consumption of the burner is 3½ to 4 amperes. If only alternating current is available, a rectifier is added in order to convert the alternating to direct current.

Fig. 2 shows a much larger type of sterilizer, the water being agitated under the light of a mercury vapor lamp, so as to turn any dust particles over and over, as these might form an obstacle to the ac-

tion of the rays on the microbes hidden underneath them. In order to make the system safe an electric connection is made between the quartz lamp and an automatic valve, so that should there be any accidental interruption of current this automatic valve acts and prevents the untreated water from entering the main containing the sterilized water.

Several municipal water supplies in France are using large sterilizers such as the one shown, which is made by Messrs. Philip J. Bertin & Co., of London, with most satisfactory results. These plants represent a total capacity of over ten million gallons per day, while the smaller

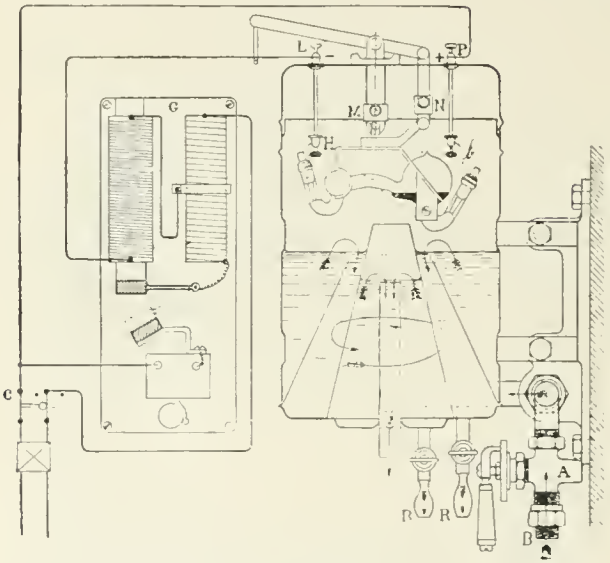


DIAGRAM *of small violet-ray apparatus, showing machine attached to tap to purify domestic water supply.*

sterilizer, shown in Fig. 1, made by the same firm, is in operation in numerous hospitals and other private and industrial concerns.

Many problems of modern hygiene are solved by the use of perfectly sterilized water, and it is often desirable and never disadvantageous to retain the salts and gases which the water contains in solution. The treatment described above does not precipitate the soluble salts, and in no way modifies the physical and chemical qualities of the water treated, the only effect being that the noxious germs are destroyed. For the use of surgeons, physicians, dentists and chemists, sterilized water is necessary, as by its use the need for antiseptics is reduced to a minimum.

Industrially, water thus purified can be advantageously employed for the manufacture of beer, artificial ice, mineral waters, and other commodities, while for washing bottles which are to contain milk, cider, vinegar, etc., it is very valuable. Research has shown that the use of sterile water for the washing of butter has a wonderful effect as, after being washed with water treated by ultra-violet rays, butter was kept for a month without suffering any deterioration.

When applied to the larger purposes of the community in general, hygienists are demanding greater purity than filters are usually able to supply. The addition of chemicals helps filtration, but the precipitants have at times not a toxic but a physical effect on the microbes, mechanically dragging them into the filter bed. The ultra-violet rays have a bactericidal effect, similar to that of sunlight.

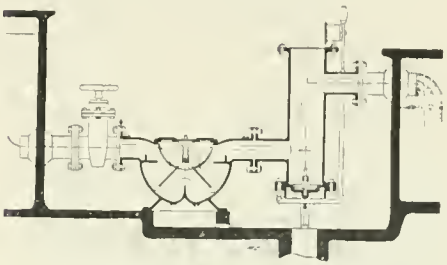
In some tests taken by Messrs. Henri, Helbronner and Von Recklinghausen at the Sorbonne University, it was found that water infected with bacterium coli was freed under the influence of a 220-volt, 3-ampere Westinghouse silica lamp within a second at a distance of 4 inches, four seconds at 8 inches, fifteen seconds at 16 inches, and thirty seconds at 24 inches. Ice, if as transparent as water, may be sterilized in practically the same time as liquid water.

The various classes of microbes are not equally sensitive to ultra-violet light. Taking for example, coli at 15 to 20 seconds, cholera is annihilated at 10 to 15 seconds, typhoid 10 to 20, dysentery 10 to 20, staphylococcus 5 to 10 seconds, pneumobacillus 20 to 30 seconds, subtilis 30 to 60 seconds, and tetanus 20 to 60 seconds.

It is essential not to interpose glass between the rays and the water, as glass is practically an absorbent of ultra-violet light. A small air space must, however, be left between the lamp and water, as if the lamp touches the water directly its temperature would be considerably lowered, and its electrical characteristics would be changed to such an extent that the light emission would be reduced, with a diminution of sterilizing action.

Taking account of the speed of the water and the energy consumed by a lamp, it is found that with 160 to 165 watt-hours per 1,000 gallons, water infected with 5,000 coli germs per cubic centimeter, can be rendered absolutely sterile. The water has, however, to be as clear as possible in order to obtain sterilization with as low a consumption of energy as possible.

In some tests taken by W. T. Burgess, F. I. C., on the eastern district supply of the London Metropolitan Water Board, England, tests were taken, first of all, on ordinary water supply from the main and then on artificially polluted water. In these tests the small type sterilizer was used, the rate of delivery being adjusted to 100 gallons per hour when the mercury lamp was turned on. After the apparatus had been working continuously for 80 minutes, samples of the water before and after exposure to the ultra-violet radiation were taken for bacteriological examination, with the results shown in Table I.



VIOLET-RAY *apparatus attached to supply pipe, with agitator, to sterilize small public water supply.*

With reference to the second column, last item, the organism found in the 10 c. c. test did not give the cultural reactions of typical coli.

On making the test with artificially polluted water, it was arranged that a very large number of organisms should be present in the water passing to the apparatus, but at the same time, the water was not only free from visible turbidity, but also did not contain any undue proportion of soluble organic or coloring matter. In preparing the water, the urban district supply was mixed with a small and constant proportion of a very highly

TABLE I.

	Water from main passing to sterilizer.	Water as delivered by the sterilizer
Organisms capable of growing on gelatine peptone medium in 4 days at 20 deg. C.	16 per c. c.	0 per c. c.
Organisms capable of growing on agar medium in 20-24 hours at blood heat...	4 per c. c.	0 per c. c.
B. coli and coli-like organisms.....	present in 10 c. c.	Not found in over 300 c. c. submitted to tests.

TABLE II.

	Eastern District water	Polluted water applied to sterilizer
Appearance when viewed in a clear glass vessel in a good light.....	perfectly clear	perfectly clear
Color meter reading.....	11.	13.
Oxygen consumed in 4 hours at 26.7 C., (80 F.) parts per 100,000.....	.058	.063

polluted water containing organisms derived from tidal Thames water, a sewage effluent, and blood heat broth cultures of microbes obtained from fresh sewage matter. The polluting liquids and cultures were all filtered thru best Swedish filter paper before addition to the large volume of water from the main. Table II gives a comparison between the normal supply and the polluted water.

It is stated that the small differences between the two sets of results are well within the limits often observed in analyses of the Eastern District water itself during the summer months.

After the apparatus had been fed with the artificially polluted water at the rate of 100 gallons per hour for 80 minutes, samples were taken for bacteriological tests, the results being shown in Table III.

It appears from the results that the rate of 100 gallons per hour was somewhat too high for complete sterilization of the artificially polluted water used in the experiment, but at the same time the results afford a remarkable proof of the enormous bactericidal power of the ultra-violet radiation. There is no doubt therefore that this practical outcome of the study which Finsen first made of the biological effect of the ultra-violet light is a matter of extreme importance from the practical standpoint of insuring sanitation and prevention of disease in large communities.

TABLE III.

	Artificially polluted water applied to the sterilizer	Artificially polluted water as delivered by sterilizer
Organisms capable of growing on gelatine peptone medium in 4 days at 20 deg. C.	11,000 per c. c.	12 per c. c.
Organisms capable of growing on agar medium in 20-24 hours at blood heat	5,200 per c. c.	10 per c. c.
B. coli and coli-like organisms	Over 1,000 per c. c.	Present in 10 c. c. not in 1 c. c.

Traffic Suitable for Various Road Surfaces

The Massachusetts Highway Commission, after some years of study and experiment has made the following statement of the effect of traffic on roads and the necessity of legislation governing the relation of width of hard tires to the loads carried by them:

A good gravel road will wear reasonably well under a daily traffic composed of 50 to 75 light teams, 25 to 30 loaded one-horse vehicles, 10 to 12 loaded two or more horse-drawn wagons, and 100 to 150 automobiles. With a larger number of automobiles, the gravel should be oiled. The oiling presents what is spoken of as a "blanket surface" consisting of heavy asphaltic oil and sand. If the oil be applied hot, the blanket surface will last 3 to 5 years, if cold, it must be renewed every year.

Oiled gravel will stand fairly well under 75 to 100 light teams, 30 to 50 heavy one-horse vehicles, 20 heavy wagons with two or more horses, and 500 to 700 automobiles daily.

Waterbound macadam will stand under a daily traffic of 175 to 200 light teams, 175 to 200 heavy one-horse vehicles, and 60 to 80, perhaps more, heavy wagons with two or more horses. If even 50 to 100 automobiles per day go over the road at high speed dust-layers will be serviceable. With a really good dust-layer the road will stand 300 to 500 automobiles a day, altho the stones will wear.

Waterbound macadam with an oil and sand blanket, applied hot, will be economical with 150 to 200 light teams, 75 to 100 heavy one-horse vehicles, 25 to 30 heavy wagons with two or more horses, and automobiles, up to 1,400, or more with fewer teams and with 50 or more motor trucks. The large number of automobiles seems to keep the oil rolled down when it would cut up and crumble without this traffic.

THE NEW CITY HALL OF SAN FRANCISCO

By Bakewell and Brown, Architects, San Francisco, Cal.

One of the notable failures in the planning of city halls is the proper co-ordination of the offices of the various departments so that they shall be convenient for the use of the public and also for the inter-communication of the employes in departments which must be constantly in touch with each other.

Some departments have little business with the public and they should be relegated to upper floors so that the public generally will not be obliged to use elevators or stairways. Other departments have fewer visitors from outside but must have constant intercommunication.

Too often the convenience of the occupants and the visitors is wholly neglected in the effort to obtain a monumental structure. Too often the convenience of one class is considered to the exclusion of the other. Too often the relative importance of various departments is overlooked so that re-arrangements must be made after the building is first occupied. The best results can be obtained only with careful study after frequent consultations with experts in the actual operation of the departments to be housed.

This brief article by John Bakewell, Jr., of the firm of architects which designed the San Francisco City Hall, states the principles upon which the arrangement of offices in this monumental building was based, and the supplementary descriptions of the floor plans will show, with the plates, the manner in which these principles have been applied. The building is so large that the reproduction of the drawings must be upon a very small scale to be brought within the limits of these pages.

THE building has four entrances one from each of the side streets down to the basement level and one main entrance from each of the two principal streets up to the first floor.

The elevators are grouped back of each of these two main entrances, two batteries of three elevators each for each entrance, making twelve in all. The offices with which the public has most business to transact are all located on this floor.

On one side the tax collector is placed between the assessor and the auditor and treasurer, this being the natural order, as the assessor makes out the bills, the tax collector collects the money and the treasurer receives the same from the tax collector and pays all bills, which have to be passed by the auditor. This completes the financial group.

On the opposite side is the recording group; hall of records, registration, bureau and civil service. There is no special connection between the units of this group, but as they must be very accessible to the public all are placed on this first floor.

On the second floor is placed the administration group. The council chamber is at the head of a monumental stairway. On one side of this are the supervisors' chambers with the city attorney and other minor offices completing this half of the building, while on the other side are the rooms of the board of works and the school department with the mayor's suite joining the two sides. This arrangement is the natural one, as the mayor must be in close touch with the board of works and the attorney and the supervisors with the attorney and the board of works.

On the third floor are located the justices of the peace, the county clerk and the engineering department. These departments have no very close connection with the rest of the departments.

On the fourth floor are located the superior courts, clerk of courts and the law library and law college. These departments were placed upon this floor as

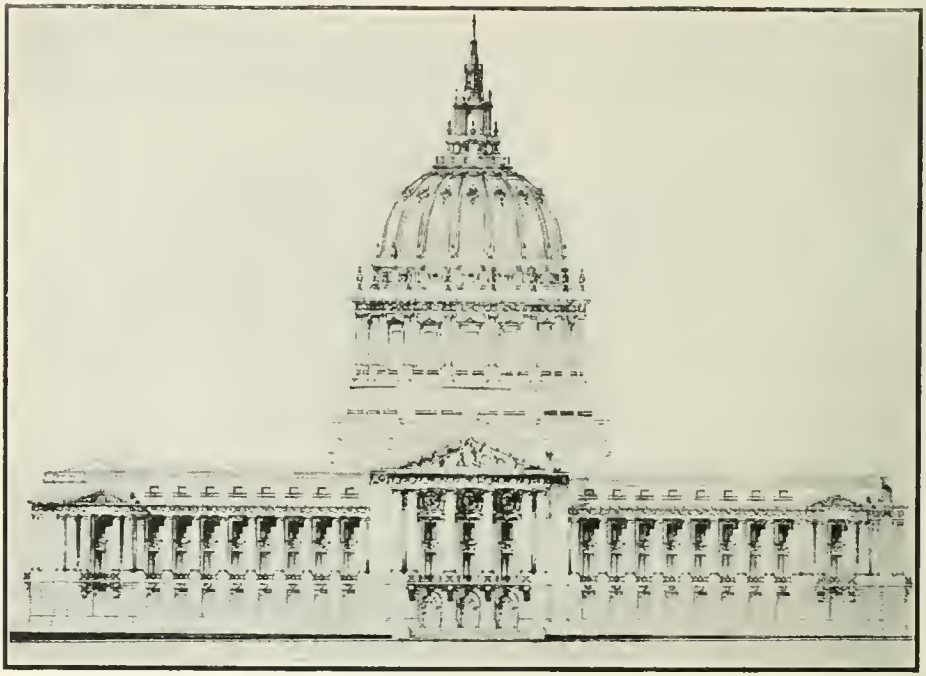
their connection with each other is close, but their connection with the rest of the building is unimportant.

The departments on each floor are connected with general corridors while the whole building is unified by the central rotunda.

The following detail of the lay out of offices, is added by the editor in description of the accompanying cuts showing floor plans.

The main floor has two entrances, on the east and west sides of the building, from Polk street and Van Ness avenue. In the center, between them, is the rotunda, extending the full height of the building, from which the offices open. On the south side is the tax collector's office, with a large public space, counters at the east and west ends of which give space for the booking and license departments and a bank counter on the south side with screens and glass windows to the screened spaces for each of six or more cashier's and assistant cashiers gives ample room for taking care of a large crowd of tax payers. This public room has a height of two stories and a skylight open to the light court. Back of the public room are the desk room for clerks and the private offices of tax collector, deputy, stenographer, bookkeeping department and the sorting room. There are numerous vaults for cash, books, storage, etc.

In the southeast corner is the assessor's office with entrances from the east vestibule and from one corner of the rotunda, with public counters for the personal property and real estate departments, but mainly devoted to the desks of the clerks and draftsmen, with vaults for records and two or three small private offices. Light shaft opens over the real estate department. Space for offices for the cashier, stenographer, coin vault and passage is taken from the tax collector's rectangle, alongside the assessor's private office. There is also a private stairway to the basement, and a toilet room. There is no direct connection between the quarters of the assessor and those of the tax collector.



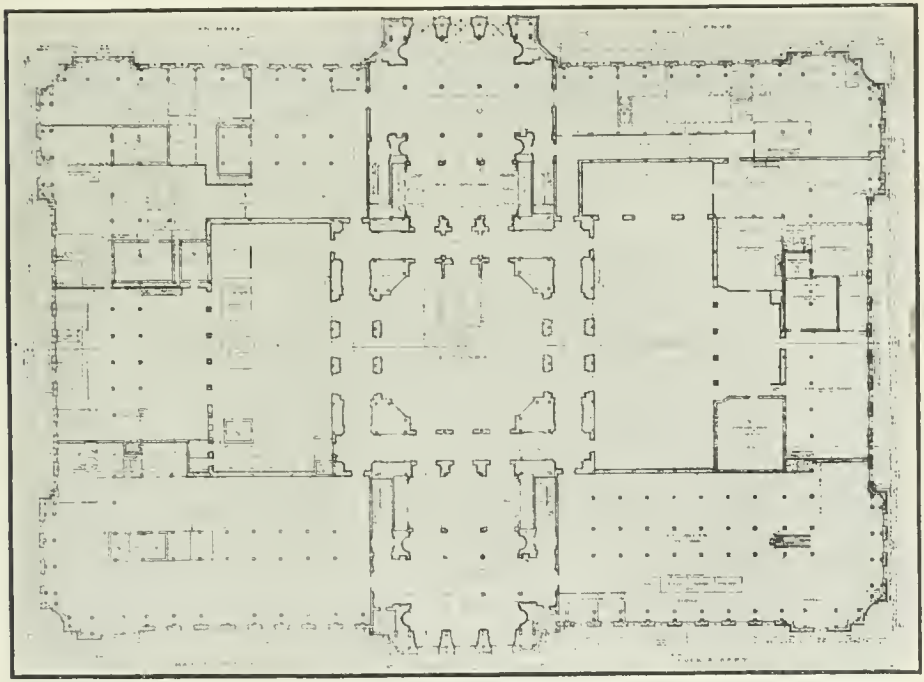
POLK STREET *elevation of San Francisco's new City Hall.*

On the west of the tax collector, with windows to the south, are the quarters of the treasurer, consisting of the small public space lighted by a light shaft and leading to the railed and screened compartments of the entry, bond and receiving clerks and the cashier, behind which is the counting room. Connected with the cashier's quarters is the cash vault, which is separated entirely from the walls of the tax collector's office which parallel it on two sides. Next to Grove street on the south with light from the windows are the treasurer's and attorney's offices with ante-room and passage connecting with the tax collector's office, and the general office of the clerks of the department. The treasurer's office has two private stairways and a private lift connecting with additional storage and vault room in the basement. Still further to the west is the room for the treasurer's bookkeepers, connected with its book vault.

The auditor's quarters occupy the remainder of the southwest corner. All visitors of the auditor and treasurer enter the public space of the auditor either from the west entrance vestibule or the southwest corner of the rotunda, those having business with the treasurer passing to the south thru a door in the partition separating the treasurer's quarters from those of the auditor. This is also the only door of communication between the treasurer's and auditor's quarters.

The main office of the auditor is separated from the public space by a large counter, and has a large book vault. The deputy's office is in the northwest corner. The record, statisticians', bookkeepers', auditors', meeting and redemption clerk's rooms are reached by a passage around the book vault, all but the last named office being ranged along the west wall with windows opening to the west.

The record, statistician's, bookkeepers', corner with a large public space and stairway to the basement, lighted in part



MAIN *floor, containing offices which the public in general must visit. Tax Collector, Assessor, Auditor and Treasurer on south side; Recorder, Registration Bureau and Civil Service Department on north side.*

by a light shaft. Along the east wall is space for the general office behind a counter with screened and windowed areas for the information, blotter, cashier and work rooms. The recorder and his deputy have small private offices.

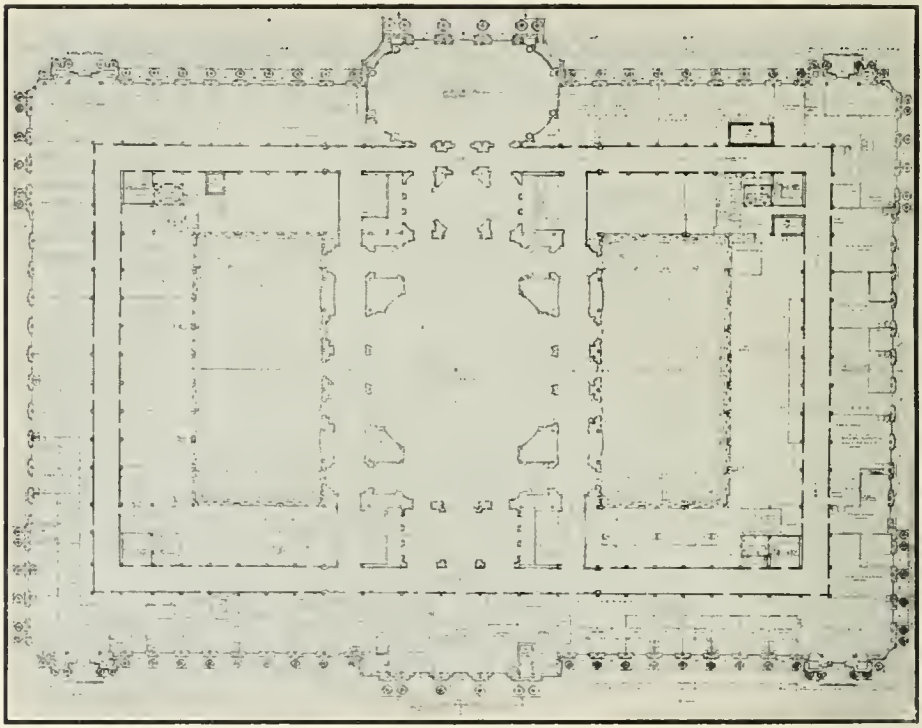
The north side of the rotunda opens by several doors into the large public space of the registration bureau which has counters with narrow space behind extending round every available space. North of this are storage vault, affidavit room and vault, clerks,' commissioners' and main offices and information bureau, the latter having a public entrance (lighted by a light shaft) from the west entrance vestibule thru a corridor used in common with the civil service department.

This civil service department is ranged along the west wall with entrances from the corridor just mentioned and into the main office from the west entrance vestibule direct. The offices are assigned to the commissioners, with meeting and ante rooms, lobby and store room, secretary, clerks, stationery and printing and record vaults.

These three departments in the north half of the first floor have no connections with each other and are very nearly independent of each other, but each of them has business with many citizens, especially the first two and each has stairways to further quarters in the cellar.

Each department on this floor has its own private toilet rooms, much ingenuity having been exercised by the architects in supplying them without encroaching on office space.

Second floor rooms are lighted either from the outside or from the large light courts above described and the four small light shafts near the outer corners, the rooms being arranged on both sides of a



THE *second floor of the City Hall contains offices of Board of Supervisors and its council chamber, the Mayor, City Attorney, Board of Education and Board of Public Works.*

corridor running entirely around the building.

The council chamber of the board of supervisors occupies the space over the west entrance vestibule and is two stories high, the offices and committee rooms extending round the southwest angle of the building.

The Mayor's offices are over the east entrance vestibule and extend to the south along the east wall and include seven rooms and passage connecting them.

The city attorney's offices, twenty or more in all, including library, are arranged around the southeast corner.

Around the south light court are the department of electricity, playground commission, public telephone station, stationery, committee, press, library and filing rooms.

The board of education occupies both sides of the east corridor north of the center, and the board of public works occupies the north rooms and those on the west, north of the council chamber.

The departments under the board of public works to which rooms have been assigned are the bureau of maintenance along the north light court and the building inspection, assessment and inspector, general office, stenographers, attorney, and commissioners and secretary in smaller rooms and suites.

The third floor is devoted to the county offices, sheriff, county clerk, justice courts in the south half and the east side of the north half.

The bureau of architecture occupies the north side between the light court and north wall with one large and two smaller drafting rooms and four small offices. The offices of the engineering department occupy the northwest corner, apparently using the drafting rooms in common with the bureau of architecture. To one unacquainted with the distribution of duties and location of division officers the space devoted to the engineering department seems small, particularly the filing department.

The fourth floor is similar in plan to the second and has court rooms arranged along the outside walls and court rooms, secretary's offices, judges' chambers, jury, reporters' and rest rooms around the light courts. The law library occupies much of the west side.

The plans of the third and fourth floors are not reproduced as they are so special in their plans and so similar in general lay out to those of the second floor and in part of the first. The three upper floors are supplied with four toilet rooms each on the inner sides of the corridor, cornering on the light courts and each one lighted by a light shaft which also gives light to the corridor. Service stairways between floors give passage between related departments on different floors.

More than usual attention has apparently been given to the proper lay out of offices and their operation after construction will be observed with interest. It is expected that the building will be occupied before the Panama-Pacific exposition opens in 1915.

West Virginia Needs Good Roads.

West Virginia has the distinction of being the only state which abandoned a state highway system and commissioner after having established them. The need for good roads has led to the establishment of a state road bureau in the railway and highway department of the State University at Morgantown, with A. D. Williams as the chief road engineer. The university is prepared to test road materials, and offers a special course in road building and maintenance for road engineers and superintendents. Mr. Williams is trying to interest the members of the county courts, who have the roads in charge, in better methods of maintenance and construction, supplying the need for advice and assistance which the discontinuance of the official state highway department has left.

PROPER CONSTRUCTION OF ROAD EMBANKMENTS

Practical Contractor Illustrates the Serious Effects of Careless Filling.

By GEORGE C. WARREN,
Before The American Society of Municipal Improvements.

At the Detroit Convention of the American Society of Municipal Improvements six years ago the writer read a paper on "Back Filling Trenches." Altho it was well received and favorably published in the engineering papers and quite widely circulated in pamphlet form, it is extremely doubtful if it has resulted in any considerable extent of reform in the long established general custom of letting the trenches "settle" themselves. Certain it is that the careless method is still the rule and we still commonly see the result of "settled" pavement laid over such carelessly filled trenches six months to twenty years after the laying of the pavement. The following item was published in August, 1913, in daily and engineering journals, the italics being inserted by the writer:

"*Large Paving Work Poorly Done.*

Philadelphia, Pa.—Because the material used to make the fill to bring the Southern boulevard up to grade *was not allowed to settle before the surface improvements were added*, it will be necessary to do over again much of the work on which the city has already spent $761,000. The highway bureau chief says the added expense of re-filling on the *boulevard, which has sunk two feet:* the relaying of concrete and resetting of conduits, man-holes and light posts, will prevent the job being completed with the $210,000 now available for the work. *The contractor shifts the blame to the ex-mayor, who, while in office, ordered the improvements put on the surface before the fill had settled. The bureau chief says that the principal filling material used was household ashes and in consequence there was much settling.* Concrete curbs and sidewalks, brick gutters and macadam roadways, electric light poles, inlets, etc., *were placed on top of this fill immediately after it had been thrown in place and before it has had a chance to settle.* The result is that these costly curbs, sidewalks, gutters, etc., are ruined and it will be necessary to throw away a great portion of this expensive surface work. Replying to the bureau chief's criticism, the contractor said *that the filling of the boulevard was done with clean ashes, earth and gravel, the very best fill to be had, strictly in accordance with the specifications.* The settlement of the paving and curbing and the finished street on top of this fill was due to the fact that *several hundred thousand yards of filling were placed in one year, without giving it the usual time for settling. The mayor ordered the paving and curbing to be done on this green fill, which was about 20 feet deep, in the same year. Under ordinary circumstances the fill would have been allowed to lie from at least six months to a year for settlement before the paving was done.* It was not so in this case, as the government officials at the navy yard were threatening to stop improvements unless the city gave them a finished street leading from the navy yard gate up to the city, and the mayor ordered the work done at once to satisfy the government officials, and said he was willing that the city be responsible for

MONTFORD AVENUE, *Asheville, N. C., looking west. Fill, 19 feet deep in center of roadway and 45 feet on right side. Fill made and bitulithic pavement laid in 1906. No settlement to September, 1913, when this view was taken.*

settlement under the circumstances, and added that the city would not be a party to stopping improvements at the navy yard."

This affords text for a flood of serious thought on another phase of the earth "settlement" problem. The Philadelphia case differs from thousands of cases which occur nearly every day in nearly all cities only in the magnitude, involving construction costing three-quarters of a million dollars; a fill 20 feet deep; several hundred thousand yards of embankment and the many miles of curb and roadway surface.

It is proper to say that the present highway bureau chief was not in any way connected with the Philadelphia public works department at the time this work was done. It should be specifically noted that, according to the report quoted above, the engineer says the fill was made with improper material, "household ashes," while the contractor says sound material was used, "the very best to be had," "strictly in accordance with the specifications," and undertakes to shift the responsibility on the poor ex-mayor who ordered the work completed promptly to avoid "stopping improvements at the navy yard."

Apparently it never occurred to any one during the period of drafting specifications and construction of the work to see that the work be done in such a way that there could be no subsequent settlement even at the expense of a little more money in original construction. Is not such neglect almost criminal?

More than 20 years ago in connection with a paving contract in Utica, N. Y., the writer had charge of the making of an embankment about 500 feet long, 50 feet wide and up to 6 feet deep. This was in a roadway extending across what is known as "The Gulf," a ravine about 75 feet deep extending thru the city, being the bed of Ballois creek, once an important stream but now a nearly extinct branch of the Mohawk river, at the junction with which old Fort Schuyler was located in the French and Indian war period. As the city grew towards "The Gulf" it had become filled with ashes, tin cans and general refuse, in face has been the dumping ground of the city for many years, the fills being made opposite the street ends. Altho made of improper material the filling was so

gradual that the embankment packed under traffic as it was made and, as above stated, at the time of paving was up to within almost six feet of the proposed sub-grade of the pavement. Could this fill be made quickly so that pavement could be laid immediately and without any settlement of the pavement? It was so made by the simple process of hauling the embankment material to the fill; spreading it in layers about 6 inches deep and thoroly rolling until solid, dampening the earth slightly with a watering cart at times when it was too dry to pack.

In connection with the laying of bitulithic pavements on French Broad avenue in 1904 and Montford avenue in 1906 in the city of Asheville, N. C., the grade, alinements and widths of the streets were materially changed, necessitating heavy cuts and fills. In some cases the entire width of the roadway was raised from 6 feet to 19 feet. In others, where the roads passed through ravines, the straightening and widening necessitated side-hill fills about 30 feet wide and from 20 to 25 feet deep. At some extra expense a 12-ton steam road roller was lowered to the bottom of the ravine, a road built for descent of wagons to the bottom and then the embankment proceeded as all embankments should, in layers thoroly rolled from the bottom to the top. Here again there was no subsequent settlement and the fill was not "allowed to lie from at least 6 months to a year for settlement before the paving was done," as the Philadelphia report says would have been allowed "under ordinary circumstances." Such a fill made according to the Philadelphia practice might continue to settle, slip and slide for 10 years, no one could tell how long.

The writer is indebted to Mr. J. T. Bostic, street superintendent of the city of Asheville, for the accompanying photographs of the French Broad avenue and Montford avenue fills and for a clear description of the conditions as follows:

French Broad Avenue Fill.

"The fill was made by Warren Brothers Company in 1904. The old street was nearly 24 feet roadbed and widened to 56 feet. We raised the old fill 6 feet high. On the west side the fill was 35 feet high when completed. There was a large storm sewer thru this fill. We began at the slope of the 35-foot fill on the west side, filling from the 56-foot slope 1 foot at a time and rolling thoroly every 12 inches until finished. On the east side

SIDE *view of 45-foot fill on Montford avenue, Asheville, N. C.*

SLOPE *on fill along Elm avenue, Baltimore, Md., looking towards Fourth avenue, from Thirty-fourth street. Fill 25 feet deep and 60 feet wide. Pavement laid in* 1908; *view taken September,* 1913. *No settlement of fill, which was laid in layers and thoroughly rolled.*

the fill was 20 feet high and was filled the same way. The filling, paving and setting of curb was all done within three months and there shows no sign of any settling whatever. Photograph No. 3 was taken at the foot of the hill looking north. You will see by the photograph that there is no sinking at all in this street.

Montford Avenue Fill.

"The Montford avenue fill was made by the Atlantic Bitulithic Company in 1906 and was an old street car track and a fill 14 feet wide on top and 26 feet high. We widened said street to 50 feet, making a fill 45 feet high when finished, filling 1 foot at a time at the foot of the slope and rolling up until street was completed, making a fill 19 feet higher than the original old street car fill. This shows no sign of sinking at all since original street was made and paved. Photograph No. 1 looking west, and No. 2 at the foot of the hill."

In the year 1907 in connection with the laying of pavement on Charles Street Avenue boulevard, Baltimore, Md., a side hill embankment was necessary quite similar to that in Asheville above described. In this case Warren Brothers Company's connection with the work was as a subcontractor laying the bitulithic surface only. The specifications required that embankment be made in 6-inch layers thoroly rolled. The general contractor insisted that the fill must be made from the top down, he claiming that wagons and roller could not be practically lowered to the bottom of the ravine. The engineer sustained the general contractor, who then proceeded to build a construction track at the top and make the fill with dump cars from an adjoining hill—a very cheap embankment but very expensive result. Fortunately in this case, before the pavement surface was laid, but after the foundation and curb were complete, "the rains descended and the floods came and beat upon" that fill and it slid several feet toward the bottom of the ravine. The general contractor fumed; blamed everyone but himself and even charged the result to the sub-contractor for the pavement surface on the remarkable theory that, if the sub-contractor had more promptly surfaced the

foundation the water would not have entered the fill and it would not have settled. One side of the street was then barricaded for more than a year waiting for the embankment to settle, to the great annoyance and inconvenience of all concerned, including the public and owners of abutting property.

A year later a condition arose in Baltimore in connection with the paving of Elm avenue, which was quite similar to Charles Street Avenue boulevard except that on Elm avenue the conditions were such as to make more difficult the lowering of the roller and building of wagon road to the bottom of the ravine. In this case the company with which the writer is connected had the general contract and, therefore, was not hampered in proper prosecution of the work. The roller was lowered and the wagon road to the bottom of the ravine was built. The pavement was immediately constructed and there has been no settlement since.

In the paper of seven years ago on the subject "Back Filling Trenches," above referred to, the writer said:

"One engineering journal recently suggested that tamping the earth in back filling trenches be done with pneumatic or steam rammer. This offers food for thought to the inventor. For the present, tamping must be done by hand."

The food for thought has borne successful fruit in the development of the Staley mechanical tamper, a most useful, simple, inexpensive apparatus which is in far too little use. The city of Wilmington has one of these Staley mechanical tampers and it is hoped its practical use may be shown to the A. S. M. I. delegates at their convention.

"Eternal vigilance is the price of success," so is this matter of earth settlement, whether it be in back filling trenches or making embankments, let the engineer make specifications requiring first class construction; see that contractors bid prices high enough to enable compliance with the specifications, and then insist on their being carried out in good faith, and we will have no more waiting at least 6 months or a year for settlement before completing the work, nor the other alternative of loss of many thousands of dollars thru subsequent settlement of the completed works.

In conclusion it is the writer's conviction that, whatever the trouble and expense may be, in all cases where fills are

ELM AVENUE, *Baltimore, Md., showing pavement laid over fill shown on preceding page. This pavement has been down five years and shows no depression.*

made in roads and pavements, whether the fills consist of back filling trenches or embankment, economy and efficiency demand that the work be done thoroly to the end that there will be no subsequent settlement.

If engineers will uniformly not only draft specifications so as to provide for such care but also see that contractors fulfill the specifications, they will be performing one of the most useful reforms in connection with road construction.

It ought not to be necessary to inform contractors in advance that specifications must be complied with, but in this important matter careless construction, regardless of specifications, has come to be so general in practice that it is well to specially and forcibly call the attention of prospective bidders to the condition of the specifications and inform them that they will be rigidly enforced. Let a few contractors pay the penalty of bidding on a basis that specifications will not be enforced, especially in this important respect, and the present carelessness will soon become history and proper construction the order of the day.

Unit Costs on Steam Shovel Excavation

One great advantage of the weekly cost sheets made out on their various jobs by the Aberthaw Construction Co., Boston, is the fact that unnecessarily high costs in any part of the work are detected and corrected before they have gone far. By thus knowing in detail just what such work costs, this company is enabled to make correct bids, where a less informed contractor would be likely either to take the work at a loss or to figure an excessive charge for it.

As an example of this method of cost keeping and its working out in service, an excavation job in New Hampshire, at which 8,022 cubic yards of material were removed from the side of a hill to make way for a building foundation, the cost figured out at 37½ cents per cubic yard. This work was done with a two-third-yard Thew steam shovel, and showed a saving of probably 8 cents per unit as compared with handwork. At the same time, it should be remembered that a great deal of railroad excavation is done at a cost of 5 to 6 cents per cubic yard, and many contractors would have bid 20 or 25 cents on the job in question—and lost money.

An analysis of the figures shows that labor alone (around the shovel, pushing and unloading the dump cars and spreading the material at the dump) accounted for practically 25 cents per cubic yard of total material handled. The items of rental of shovel and track, repairs, etc., were so small that, figuring on these as a basis, a much lower figure than that obtained would have been bid by an inexperienced contractor. This shows in a very clear way the advantage of an exact cost accounting system on jobs of this sort as a guide to future work.

Most of the material was dry gravel with a small percentage of boulders. It was carted off in dump cars pushed by hand back and forth on a standard contractors' track (500 feet) carried on a trestle about 10 feet above the ground. The average haul was about 400 feet; the shortest haul, 200 feet. The unit costs are shown in the following table in cents per cubic yard:

Labor around shovel, pushing cars, unloading, and spreading at the dump	22.9
Repairs, $18.58; rental of shovel, $345.00	4.5
Labor on track, including 10-ft. high trestle	3.5
Labor for unloading, placing, etc., at the job	3.1
Rental of track	1.4
Labor at Boston end (including riggers' bill)	1.25
Freight on shovel and parts (both ways)	0.85
Total	37.5

How the New York Purchasing System was Established

MANY PARTS OF THIS SYSTEM CAN BE ADVANTAGEOUSLY COPIED BY SMALLER CITIES.

By F. X. A. Purcell, Bureau of Standardization of Supplies of the City of New York.

This illuminating exposition of the necessity for standardizing supplies for city departments and methods of purchasing the same is taken from a paper before the Municipal Engineers of New York City and indicates the methods by which millions of dollars are saved to the city.

SUPPLY purchasing has not long been considered a business proposition, perhaps from neglect, perhaps because regarded as a legitimate means for payment of political debts. Civil service has had more attention and has been established very generally altho the pay roll may not be more than five times the amount of the city's purchases.

Awakening has come thru the results of combined buying by large organizations, by long strings of department, grocery, tobacco and ten-cent stores, restaurants and the like. Low prices are possible thru central buying and this argument is irresistible. Business men urge cities to follow these examples as a step toward lowering taxes, a long step in New York, which spends $20,000,000 a year for supplies.

Washington is providing a fireproof warehouse to store and handle supplies purchased by its purchasing officer, appointed after a Congressional report made in 1912. Los Angeles established by ordinance in December, 1912, a store department with purchasing, store and mechanical divisions. Cleveland's purchasing department has saved far more than its cost. Philadelphia has lost some of the greatest advantages of its central purchasing system of several years standing by lack of adequate storage facilities. Chicago has the central purchasing agency and storehouse. Cincinnati began its central purchasing this year.

New York City began its enormous work of standardizing supplies and purchases in 1909 in the establishment of standard specifications by the Board of Estimate and Apportionment for all supplies purchased. A Select Committee was appointed, composed of Mayor, Comptroller and President of the Board of Aldermen, to supervise the work.

An advisory commission of five with Deputy Comptroller Fisher as chairman, was chosen by the Select Committee and the active management was placed in charge of Mr. W. Richmond Smith. The organization built up by Mr. Smith has since been designated as the Bureau of Standardization of Supplies of the Board of Estimate and Apportionment.

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UNDER *the old system the same supplies were never described alike by various departments, making inspections almost useless.*

The Departments were and are in the habit of describing the same supplies so differently and so incompletely as to minimize competition and to make inspection of supplies almost useless. They also differ greatly in their choice of articles to be used for similar purposes. It was necessary to establish a definite qual-

ity of supplies for use in all purchases by city departments. Only a city of the first magnitude could afford such a step, and the proper completion of this work by the City of New York will make it unnecessary for the smaller cities because surely no city will find a need for an article not included in the supply list of New York.

The Commission on Standardization of Supplies began work in July, 1910.

The first step was necessarily to compile a list of the articles commonly purchased by the city, taking some one year as a basis, with the amounts expended on each item, so that a classification for contract and accounting purposes might be established, a guide afforded for the choice of standards and a basis furnished for the determination of the relative importance of the items.

Accessible lists of supplies in the offices of the departments were incomplete or were in different terms and it was found practically impossible to create a uniform record of the amount annually expended for each item. No help therefore, could be obtained from these sources. It was necessary to go to the original vouchers on file in the Department of Finance.

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IN order to prepare proper classifications for standardization of purchases it became necessary to examine over fifty thousand vouchers.

To undertake this task required courage and patience, for in the year 1909, which was taken as a basis, 50,000 vouchers were paid for supplies and all of them had to be examined. The list, comprising 18,000 items, was completed in the latter part of last year, in card index form, by departments, summarized in schedules, showing the purchases of each item by each department, with prices paid.

As items grew into classes, the classes were named, no arbitrary classes being fixed in advance. As finally corrected they are believed to be a reasonable division of the supplies purchased and such as will admit of the letting of a contract within a single class. The list of classes is printed in every contract form and is no doubt familiar to all. It is as follows:

1. Apparatus (laboratory, etc.)
2. Arms and supplies, ammunition and explosives.
3. Athletic goods (including games, toys, etc.)
4. Books, publications, etc.
5. Cleaning materials and compounds.
6. Cleaners' machines and supplies.
7. Clothing, etc.
8. Cordage, rope and oakum.
9. Drafting and engineering tools, instruments and supplies.
10. Drugs, chemicals, etc.
11. Dry goods, notions, etc.
12. Electrical fixtures and supplies.
13. Fire apparatus and appliances.
14. Food products.
15. Forage (including all food for animals).
16. Fuel (including fuel oils.)
17. Furniture and furnishings (including kitchen supplies and utensils).
18. Hardware (not otherwise classified).
19. Hospital supplies and surgical instruments.
20. Iron, steel and other metals (including castings).
21. Leather, saddlery, belting, hose and hose fittings.
22. Live stock (including horses and all other animals) and laboratory specimens.
23. Machinery and parts (not otherwise classified).
24. Materials of construction (including lumber, timber and building material).
25. Materials for manufacture of prison goods.
26. Miscellaneous.
27. Nails, bolts, nuts, washers, rivets and screws.
28. Nautical suplies (including boats and equipment).
29. Office equipment (other than furniture) supplies and stationery.
30. Oils (lubricating and illuminating), greases and lubricants.
31. Paints, oils, varnishes and painters' supplies.
32. Pipe, valves and pipe fittings.
33. Photographic materials and supplies.
34. Plumbers', steamfitters' and machinists' supplies.
35. Printed, lithographed, engraved and bound books and forms.
36. Rubber goods (not otherwise classified).
37. Stable equipment and supplies.
38. School supplies (not otherwise classified).
39. Seeds, plants, shrubs, trees, etc.
40. Tools and implements.
41. Vehicles (including automobiles, trucks, wagons, carts, carriages, bicycles and motorcycles).

42. Wire rope and wire.

As each class became large enough to indicate the kinds of supplies used, the preparation of specifications was begun.

First a study was made of the different articles used by different departments for the same purpose, and a single standard was presented to all departments for adoption. The standard was not always the best of its kind but was of the sort apparently best suited to its purpose. In no case was the standard such as to limit competition.

When conditions proved it necessary several qualities were provided for, either thru separate specifications or in the same specification.

The cooperation of all departments was earnestly sought and in most cases cheerfully given. It was realized that the special requirements of each department were best known to the department officials and many conferences were held so that these special requirements might be brought out and discussed.

A standard of quality decided upon, the next step was to learn the points which governed its quality in order that they might be described.

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¶ A RESEARCH *laboratory was necessary in order to properly establish standards.*

It was in the choice of standards that the need became evident of a laboratory to make research tests and to establish quality grades in the making of specifications and also to enforce the carrying out of completed specifications by the test of samples taken from deliveries. A conference attended by engineers representing the Borough Presidents and by the Chief Engineer of the Board of Estimate and Apportionment, resulted ultimately in the establishment of a thoroly equipped, adequately manned and centrally located standard testing laboratory, by resolution of March 13, 1911, providing for the testing of samples of all kinds of supplies purchased for the city, for auditing purposes; the testing of materials of construction; the carrying on of research work for the benefit of all departments; the supplying to the commission on standardization of the scientific and technical data for the preparation of specifications; the maintenance of central records showing the length of life and the qualities of materials of construction; the issuance of bulletins bearing on these subjects; the furnishing to the corporation counsel of data to protect the city's interests in legal actions.

The activities of the Standard Testing laboratory under the direction of Mr. Otto H. Klein have continuously justified its creation, the choice of standards was simplified and has progressed more rapidly.

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¶ VALUABLE *information secured from trade experts prior to the adoption of specifications.*

Trade experts were consulted so that as wide competition as possible might be secured and then the specifications were written. Copies were sent for criticism to all departments interested and to manufacturers and dealers handling the article. Thoro consideration, and if necessary deeper investigation, was given to every criticism received, and not until all were agreed or it was found hopeless to bring them to agreement was the specification submitted to the Select Committee for approval and then to the entire Board of Estimate and Apportionment for adoption.

By the end of 1912, two hundred specifications were thus made effective, covering practically all the commonly used articles in classes 5, 14, 15, 16 and 22 of the above list.

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¶ A SAVING *of one cent per pound on meat purchases amounts to* $50,000 *a year.*

It is difficult to estimate the saving in which the use of these specifications has resulted but the conditions corrected convey some idea. A saving of one cent a pound in meat, formerly purchased at prices above the market, results in a

total saving of over $50,000 a year. Forage costs the city about $900,000 annually. The establishment of specifications requiring the official gradings of the New York Produce Exchange has saved the city a considerable sum. There is a saving of six cents per pound on butter, an annual saving of more than $25,000. Seasons were established for the use of fresh fruits, vegetables and fish, preventing the purchase of seventy-five cent strawberries and eighty cent fish. The fixing of weights, of sizes or of quantity per package enforced the delivery of known quantities of fruits and vegetables instead of unknown, "boxes," "crates," and "bunches." These are only a few of the results effected but they serve as illustrations.

While the work on the supply list and the specifications was progressing, the forms of contract used by all departments in the purchase of supplies were examined and a standard form was prepared, embodying their best features, but providing for the letting of contracts under definite class heads and for a uniform type of bid. This form of contract was adopted July, 1912, and was used during the following year. Advantage was taken of the year's experience in modifying the form, which is now in general use.

The work of the bureau up to this point was accomplished by Mr. Smith and his assistant, Mr. Donovan, with a force of small salaried clerks and typewriters never exceeding eight persons.

In September of last year a transfer of funds from the appropriation for the Department of Finance made possible the appointment of the first member of what is now known as the "field staff" so called because the work is mostly away from the office, and which now numbers six, five of whom are engineers. The sole duty of the field staff is the preparation of exact, concise, just and "perfect" specifications of items ranging from nursing nipples to automobiles. If the specifications are not exact and concise, the staff hear of it from Mr. Smith. If they are not just they hear of it from the trade. If they are not perfect, the departmental engineers tell them about it.

There were many civil service difficulties in the appointment of the field staff, the effort being to transfer from other departments men familiar with supplies, either from the purchasing or the laboratory standpoint.

The following principles were laid down for the guidance of the staff:

Specifications shall be in unit form.

No specifications shall mention a manufacturer's name or a trademark.

The words "equal to" shall not be used.

Inexact adjectives shall be avoided.

When possible, tests shall be specified. When two tests are possible, one complete occupying four hours say, the other sufficiently complete to assure the quality specified, occupying say fifteen minutes, the latter test shall always be used.

Except in rare cases, specifications shall not provide for showing or requiring samples.

Since the beginning of the year specifications have been prepared for the following classes in the above list: 1, 7, 8, 10, 11, 19, 20, 21, 23, 24, 25, 30, 31, 34, 40, from two to 145 specifications in a class, making a total of 622 specifications prepared this year, or a grand total of 822 specifications in use.

Of these later specifications, 380 have been approved by the Select Committee and have been submitted to the Board of Estimate and Apportionment for adoption and promulgation.

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Q ONE *of the greatest difficulties in setting up standards was encountered in obtaining agreement between department heads.*

In many cases the greatest difficulty experienced was in bringing department officials to agree upon standards. In all cases, it is believed, a wise choice was made.

Another difficulty was in obtaining reliable information. Most of the merchants and trade experts consulted expressed willingness to assist but, naturally, many were averse to imparting trade secrets. It is behind these trade secrets that trade deceptions lie and considerable effort was expended in unearthing them.

Only in a few cases has it been necessary to provide for the showing of samples. Trade gradings have been used wherever they are well established.

The specifications in their present form are not believed to be perfect. They are the best that can be expected before trial confirms their usefulness or suggests the way to improve them.

Since the beginning of the year work has progressed rapidly in preparing schedules of purchases in 1911 which will add to the list of 1909 such items as were missing.

If proof was needed that the city's method of buying is at present wasteful, it was supplied by the schedules of the purchases in 1909. An examination of the vouchers showed that many vouchers were passed for amounts less than the cost of handling them. Hundreds of vouchers bore so meagre a description of the articles purchased that it was impossible to classify them. Only a small proportion of the contracts or orders were awarded to manufacturers or wholesalers. Discounts for prompt payment were never allowed because they were not earned. Prices paid for the same kind of goods differed as much as 300 per cent. Long lists of supplies were purchased under a single contract or order and paid for in lump sum, making auditing virtually impossible. Items were grouped:—hardware mixed with dry goods or soap mixed with rubber hose, so that no legitimate merchant could bid.

In collecting data for the specifications it was learned that manufacturers, commission merchants and wholesalers have become accustomed to do business with the city thru middlemen, in some cases paying a commission to the middlemen, in others charging regular prices, leaving the middlemen to make what profits they could. This is due to the distaste felt by the greater merchants for business as small and as troublesome as departmental transactions usually are, and because they have felt that the middlemen were possessed of the password that brings city business.

The merchants welcomed the opportunity to enter fair competition and in most cases proved that they could do better for the city than the middlemen can.

Inquiry developed that there are 120 officials vested with authority to buy supplies and that there are more than 2,100 places where supplies are received from vendors and therefore many hundred men intrusted with the power to accept or reject deliveries.

It would take an extended investigation to learn how many men are employed in these numerous places in the purchase, distribution, storing and accounting for supplies. All of the extravagance, the abuses and the waste can be traced to the lack of cooperation between departments and the lack of a central control.

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¶ THE *purchasing system used by one of the large railroad corporations studied as a model.*

To learn of these things was comparatively easy, after the supply schedules were started. To suggest the remedy required months of study of the methods of progressive corporations and of the peculiar problems in city business.

The Canadian Pacific Railway was the most studied model because of the great variety of supplies used in its railway, steamship and hotel systems and because of the great courtesy of Sir Thomas Shaughnessy, its president, who instructed his subordinates to give to the city's representatives all the time and all the information required for their purpose.

In February of this year, Mr. Smith presented to the Comptroller a plan embodying the essentials of the Canadian Pacific scheme of routine and records of buying and handling supplies, modified to suit conditions imposed by the charter of New York.

This plan has been printed by the City Comptroller, William A. Prendergast, and a bill has been prepared for submission to the legislature providing the necessary legislative authority for the central purchase and distribution of supplies for the city.

DETROIT'S MUNICIPAL ASPHALT PLANT

By H. B. Pullar, Engineering Chemist, Detroit, Mich.

THE City of Detroit has during the past ten years, maintained and operated its own municipal asphalt paving plant, which plant, during the first eight years of its existence, made an estimated saving of over $200,000.00 to the city. This estimated saving was made by comparing the lowest bids on work obtained previous to the installation of the municipal plant and the actual cost of work laid by the city.

The municipal plant is in charge of Mr. Clarence H. Proctor, a well known and recognized asphalt expert. The asphalt pavements in Detroit are in excellent condition and repairs are never neglected. The condition of these pavements together with the accrued saving during the first eight years, are ample proof of the fact that municipal plants under expert supervision are good investments, and this is especially true in states where the laws permit municipalities to do new work as well as repair work.

The original municipal plant is a Hetherington & Berner, consisting of two mixers, one for binder and the other for top; two drying drums, melting tanks and storage bins. After a few years this equipment was found to be insufficient for the rapidly increasing demand for asphalt pavements and an addition was made to the plant by installing a Cummer drum, tank and mixer. The demand for asphalt pavements continued to increase until during the past year it was found necessary to add an entire new plant which consists of an up-to-date Hetherington & Berner complete asphalt plant. This new plant is of the highest type and consists of two mixers, one for binder and the other for top, two drying drums, two open tanks and two agitators or pressure tanks. This new equipment was installed at an approximate cost of $22,000.00 and the total value of the Detroit municipal plant and equipment at the present time, is estimated at $75,000.00.

The city maintains a laboratory at the plant where the mixtures are tested daily and where all raw materials are carefully tested before being used. The mixture is produced by men of long experience and under the personal supervision of Mr. Proctor, thus insuring a uniform and high grade mixture at all times. As the success of an asphalt pavement depends almost entirely upon the way the materials are handled at the plant, this is of the utmost importance and can be cited as the principal reason for the successful asphalt pavements in Detroit.

Between ninety and one hundred men are employed at the plant. The laborers there receive $2.50 per day, straight time during the paving season, and the experienced men receive pay in proportion to their ability and experience. The plant, while under the direct charge of Mr. Proctor, also has a superintendent, thoroly familiar with the business, who receives a salary of $1,800 per year. The superintendent, time-keeper and book-keeper are the only people retained during the whole year, the rest of the labor, as stated above, being confined to the paving season.

After the mixture has been produced at the plant it is drawn to the streets in forty canvas-covered wagons, hauling two and a half cubic yards each. These wagons cost $155.00 each, f. o. b. Detroit. During the past year, two five-ton asphalt trucks have been added to the equipment. These trucks were made by the General Motors Co. and cost $4,500.00 each.

As has been the general experience thruout the country where trucks are used, they have proved of execptional value for long hauls and have materially reduced hauling charges. Previous to the installation of the trucks, it took from two to three hours to make the long hauls, which

DETROIT *municipal asphalt plant furnished by Hetherington & Berner and operated by the Detroit Municipal Asphalt Maintenance Department.*

are now made by the trucks in from twenty to thirty minutes. The short hauls are still made by wagons, which for such hauls have been found to be more economical than trucks.

The total capacity of the Detroit municipal plant of today is between 2,500 and 3,000 square yards of finished work per day, the finished pavements consisting of 1½ inches of binder and 2 inches of wearing surface. The city will lay between 300,000 and 400,000 square yards of work per year, of which about 25,000 square yards is repair work, including cuts made by the public service corporations. During the present year it is estimated the following quantities of materials will be used:

Asphalt	4,000 tons.
Asphalt sand (for top)	25,000 cu. yds.
Limestone (for binder)	12,000 cu. yds.
Limestone dust (for filler)	2,500 tons.

The cost of these materials f. o. b. plant being:

Sand	$ .72 per cu. yd.
Limestone	.90 per ton.
Limestone dust (In paper sacks.)	3.15 per ton.

The city contracted for 3,000 tons of various kinds of asphalt f. o. b. Detroit, as follows:

	Tons.	At per ton.
Bermudez asphalt	1,500	$28.15
Montezuma Mexican asphalt	1,000	29.12
California asphalt	500	20.50

About three car-loads of asphalt are used each day, and during the paving season over 2,000 car-loads of materials are received and handled at the plant.

The asphalt, after being received at the plant, is stored until ready for use, and when ready it is first stripped and then taken up into kettles by means of a revolving chain with hooks. It is then put into the melting kettles and flux added to bring the asphalt cement to the desired consistency, the flux varying in proportion according to the brand of asphalt used. For the Mexican and California brands of asphalt, about three pounds of flux to one hundred pounds of asphalt is required, and for Bermudez asphalt, about twelve pounds of flux to one hundred pounds of the refined asphalt, the resulting penetration of the asphalt cement being from 50 to 60, depending upon the traffic of the street on which the material is to be used. Craig residuum oil is used for flux and is obtained in tank cars at the price of approximately $11 per ton, delivered.

Coal is used for fuel and is obtained at a price of $2.50 per ton at the plant and the small amount of wood used is obtained at $7.50 per cord.

The asphalt mixture as it is turned out from the plant varies slightly in the per cent. of bitumen, depending upon the kind of materials being used. For the so-called oil or pure asphalts, the standard mixture calls for 11 per cent. of bitumen, while for the so-called natural asphalts, the standard is 10½ per cent. The per cent. of dust also varies slightly, according to the traffic conditions of the street, but is usually maintained at from 7 to 12 per cent.

After the mixture comes from the plant it is taken to three different street gangs, one gang doing repair work, while the other two are on resurfacing and straight new work. Each of these gangs consists of about twenty men as follows:

One foreman		
Four rakers	$3.50	8 hours
Three tampers	3.00	8 hours
One smoother	3.00	8 hours
Two apprentices	2.65	8 hours
Eight laborers	2.25	8 hours
One roller man.....	4.50	10 hours

All of the men receive straight time during the paving season but are released during the winter months. The rakers, smoothers and tampers are all union men, belonging to the Detroit Pavers' Union. They are thoroly experienced in laying asphalt pavements and are big factors in giving the excellent results obtained.

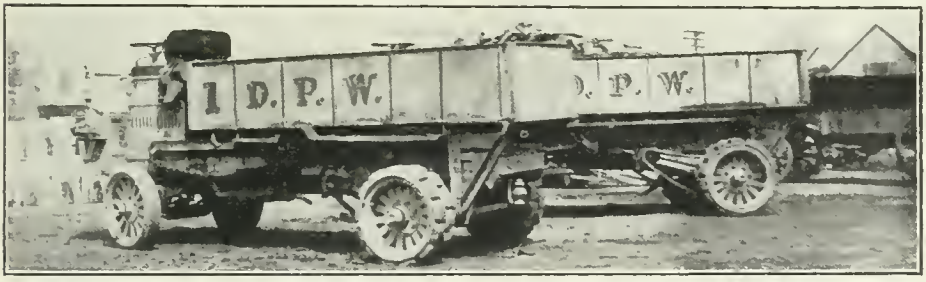
The work of the municipal plant is divided into three distinct classes. The classes and the average cost of the work of each are as follows:

Resurfacing work	$1.13 per sq. yd.
Paving and repaving (new work)	1.05 per sq. yd.
Patching	1.00 per sq. yd.

The apparent high cost of the resurfacing work is due to the fact that considerable of this work is the resurfacing of old cedar block pavements and required about 3½ to 4 inches of surface mixture.

At the end of the present season there will have been laid by the Detroit municipal plant, approximately 1,800,000 square yards of pavement or about 125 miles of asphalt streets.

There are many valuable suggestions to be taken from the Detroit municipal asphalt plant, the principal one of which is the fact that this plant is under the direct supervision of an asphalt expert, a man thoroly familiar with the business and who employs only expert labor, for without doubt a large per cent of the failures of bituminous pavements thruout the country can be attributed to the careless or inexperienced handling of the materials at the plant and on the street and it would be well for engineers and city officials interested in the development and operation of municipal plants, to investigate and absorb the number of good features of the Detroit municipal plant which has proven without doubt to be a success and a very valuable asset to the city.



TWO *five-ton motor trucks used by Asphalt Maintenance Department at a great saving on long hauls.*

Type of Motor Fire Apparatus in British Use.

By Thomas Reece, London, Eng.

ALTHO horses for motive power still figure very largely in the fire prevention service of even the biggest British cities the movement towards the motor engine grows stronger. Several firms are now building fire brigade motors, the specifications ensuring speed, reliability, durability and adaptability for all kinds of roads and emergencies that are in the up-to-date fire engine. One order for the London fire brigade was recently for sixteen such engines; these were of either 60 h.p. or 75 h.p. The Birmingham fire brigade took eight similar models quite recently, and Glasgow five. A turbine pump equipment went with these, this pump being of the centrifugal multi-stage high pressure turbine type. It delivers approximately 400 gallons of water per minute at 120 pounds pressure and will deliver up to 500 gallons per minute at lower pressures, when working thru 100 feet length of 2¾-inch unlined canvas hose. The engines are also fitted with an airpump charging apparatus with a capacity for lifting water from a depth of 29 feet in as many seconds. This apparatus is very efficient as it has two double-acting cylinders, each working independently.

In all these makes a reserve of horse power is allowed for and the makers guarantee that the engines will not have to run "all out" to give the stipulated output. They are equipped for various types of fire escape ladders or chemical first-aid tanks. A description of the 75 h.p. model which is now so popular will not be out of place.

The six-cylinder engine is of enclosed vertical type, cylinders cast separate, valves mechanically operated and placed on opposite sides with pressure feed lubricating system on the latest principle. This engine is 5-inch bore by 6-inch stroke, designed in all details essentially for fire brigade work, and will supply a reserve of horse power in case same is required. The latest model of automatic carbureter is fixed. The ignition is high tension waterproof Bosch magneto, and also high tension electric with accumulator and distributer, connected with two sets of sparking plugs with turn-over switch, and to be coupled up in such a way that each separately or both ignitions together can be used; twelve sparking plugs being fitted in all. The clutch is leather lined cone shaped, of large diameter and approved design, with outside adjustment for spring tension and a universal joint contained in the clutch to avoid all strain on the crank shaft, thru any distortion of the frame which may occur. The speed gear box is of special alloy aluminum casing, four speeds forward and reverse, which would enable the machine to attain a speed of 35 miles per hour on the level; gate control with ball bearings thruout; machine also capable of ascending a gradient of 1 in 5 with full load. The pump gear box is also of special alloy aluminum oil-tight casing, gear wheels mounted on hardened shafts and ball bearings. A foot-brake drum of large diameter is fitted on the end of the gear box shaft, and two cast iron slippers, bearing on this drum, are operated by means of a double cam movement. These brakes are capable of holding machine on a gradient of 1 in 5. Arbor and pump shafts are of high tensile steel.

The back brakes are internal expanding and made of two cast iron shoes operating against the inside of large diameter drums on the rear hubs, entirely cased in and dustproof. The parallel pinion type of differential is fitted with six planets and two star wheels. The front axle is modern, ample, and of wrought steel.

BIRMINGHAM, *England, ladder and pumping auto fire truck. This apparatus is equipped with an air pump capable of lifting water from a depth of 29 feet in as many seconds.*

Steering is worm and segment irreversible, adjustable with ball connecting joints; all joints are covered with leather casings. Turning radius is as small as possible.

Lubrication is entirely automatic thruout, being pressure feed system on well tested and satisfactory lines.

The frame is of channel steel especially strengthened at the points necessary; the underframe carries engine on three-point suspension.

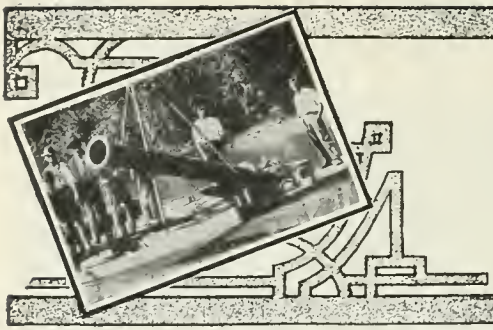
The engine is water-cooled and the wheels are of artillery wood or steel for carrying 34-inch solid rubber tires. The machine will ascend any ordinary gradient on direct drive and will ascend a gradient of 1 in 5 on the lower gears.

The air-pump charging apparatus is very new and in duplicate, there being two double-acting cylinders each working independently, and constructed of a capacity capable of obtaining water from 26 feet or 27 feet in 20 to 25 seconds. The air-pump is brought into action by a lever from the driver's seat, and on the water being obtained, the outlets, if required, automatically open. The whole of the work is done from the driver's seat, and it is not necessary for anyone to go near the pump at all, and no tank of water is required.

The gasoline tank is under the driver's seat and holds 25 gallons.

Three 10-foot lengths of suction hose 5-inch diameter inside of the imbedded wire type are carried, fitted with polished gunmetal screwed unions, with full clearance, copper strainer at end, polished. The body is constructed of the best seasoned wood, and arranged to carry some 1,500 feet of delivery hose, and also fire engine tools in separate locker. The engine seats four men each side facing sideways, and driver and officer in front with brass handrails. Two separate long boxes are arranged at the sides in a convenient position for carrying stand pipes and other gear, the lids forming side steps. Polished brass edging is round, all steps and tops are covered with pyramid pattern aluminum tread. The rear step will accommodate another fireman.

The machines are painted fire engine red and lined white with gold leaf mouldings, the name of the fire brigade being painted in double gold block letters. The usual three lamps are carried.



EDITORIAL

INCREASED EFFICIENCY IN MUNICIPAL SOCIETIES.

In these days of demands for efficiency in municipal operations as well as in private business, the existence of two societies, devoting themselves to the discussion of the same subject, the standardizing of paving specifications, was a duplicate of effort and expense which, after the first year or two of hard work on the part of one of these organizations, did not seem to be justified. The two societies have been discussing amalgamation during the entire life of the newer organization and at the meeting of the American Society of Municipal Improvements at Wilmington, in October, a method of combination satisfactory to both was agreed upon and the consolidation is now an accepted fact.

The A. S. M. I. is now twenty years old but has paid special attention to the standardization of specifications for only five years, while the A. S. P. S. was about four years old. Ex-President Geo. W. Tillson, of the younger society, becomes the chairman of the general committee on standard specifications of the older organization and the members of the committees of the A. S. P. S. become members of the corresponding subcommittees of the A. S. M. I. The latter society returns to a former custom and provides for municipal memberships, a city member being authorized to send as many delegates as it chooses to pay for at $5 a year each and to have as many votes as it has delegates. In this way, the specialized society transfers its activities to the corresponding department of the organization with the larger field and there should be increased efficiency by this concentration of experts.

ELECTRIC LIGHTING ADVANCE.

We seem to be on the verge of another material advance in the field of electric lighting which has already been the field of so many striking

discoveries. The theories set forth in articles and association proceedings seem to be well demonstrated and it only remains to work out the details for successful application to practical use. The new nitrogen lamp will soon be on the market and the new lights on the luminescent principle of the mercury vapor lamp will not be far behind. The articles in this number of Municipal Engineering give the latest information.

GARBAGE DISPOSAL IN CHICAGO.

The garbage controversy in Chicago has become so acute that the city is now dosing its garbage with chemicals and dumping it in abandoned clay pits of brick works in the vicinity and is advising householders to destroy as much of it as possible on the premises so as to reduce the amount of trouble for the city forces as much as possible. To an outsider this seems wholly inexcusable and to be due wholly to the failure of the city council to put the solution of this technical and highly complicated problem in the hands of technical experts with instructions to work it out with reference only to the sanitary and engineering questions involved and with due regard to economy.

Such questions as method of disposal of the garbage and refuse depend so much upon the methods of collection and upon the difference in conditions in various parts of the city and in various business and household districts that no city council or health board can answer them without detailed information and recommendations obtained and made by experts in the field after careful study and measurement of the conditions, quantities and qualities of materials to be handled.

Whether the collection or the disposal or both shall be by contract or under municipal operation are also questions which require the advice of experts before a safe basis for a decision can be laid.

When the decision is made the carrying out of the project must again be put in the hands of experts if satisfactory results are to be obtained.

There are enough examples of successful and partially successful plants under both municipal and private ownership now to demonstrate the truth of these statements and to emphasize the follies of which the city council and perhaps other city officials have been guilty.

QUESTION DEPARTMENT

Specifications for Elevated Tanks and Standpipes and for Pipe Laying

In MUNICIPAL ENGINEERING for July, p. 98, you refer to specifications for elevated steel tanks and standpipes by C. W. Birch Nord.

I would like to get a copy of those specifications and also specifications for pipe laying. P., ——— Conn.

The specifications for elevated tanks and standpipes may be found in the Transactions of the American Society of Civil Engineers, vol. xliv, p. 526, and are as follows:

Loads.

1. The dead load shall consist of the weight of structural and ornamental steelwork, platforms, roof construction, piping, etc.

2. The live load considered shall be the contents of tanks, the movable load on platforms and roofs, and the wind pressure.

3. The weight of water shall be assumed to be 63 pounds per cu. ft., and that of crude oil 56 pounds per cu. ft., 1 cu. ft. of fluid being equal to 7.48 gal.

4. The live loads on platforms and roofs shall be taken at 30 pounds per sq. ft., or a 200-lb. concentrated load applied at any point.

5. The wind pressure shall be assumed at 30 lbs. per sq. ft., acting in any direction. The surfaces of cylindrical tanks exposed to the wind shall be calculated at two-thirds of the diameter multiplied by the height.

6. The movable live load on platforms and roofs shall not be consider as acting together with the wind pressure.

Unit Strains.

7. All parts of the structure shall be proportioned so that the sum of the dead and live loads shall not cause the strains to exceed those given in Table 1.

8. For compression members, the permissible unit strain of 16,000 lbs. shall be reduced by the formula:

$$p=16{,}000-70\ l/r$$

where p=permissible working strain in compression, in pounds per square inch;

l=length of member, from center to center of connections, in inches;

r=least radius of gyration of section, in inches;

the ratio l/r shall never exceed 120 for main members and 180 for struts.

9. Stresses due to wind may be neglected if they are less than 25 per cent. of the combined dead and live loads.

10. Unit strains in bracing and other members taking wind stresses may be increased to 20,000 pounds per sq. in., except as shown in Section 9.

TABLE 1.

	Pounds per Square Inch.	
Tension in tank plates	12,000	Net area
Tension in other parts of structure	16,000	Net area
Compression	16,000	Reduced
Shear on rivets and pins	12,000	
Shear on bolts and field rivets	9,000	
Shear in plates	10,000	Gross section
Bearing pressure on rivets and pins	24,000	
Bearing pressure on field rivets	18,000	
Fiber strain in pins	24,000	

11. The pressure given in Table 2 will be permissible on foundations and bearing plates.

TABLE 2.

	Tons per Sq. Ft.
Soft clay	1
Ordinary clay	2
Dry sand and dry clay	3
Hard clay	4
Gravel and coarse sand	6

	Lbs. per Sq. In.
Brickwork with cement mortar	200
Portland cement concrete	350
First-class sandstone	400
First-class limestone	500
First-class granite	600

Details of Construction.

12. The plates forming the sides of cylindrical tanks shall be of different diameters, and shall be calked from the inside. No foreign material shall be allowed when calking.

In oil-tank work, both the inside and outside of the tank shall be beveled for calking.

13. Joints for horizontal seams and for radial seams in the spherical bottoms of tanks shall preferably be lap joints.

14. For vertical seams lap joints shall be used for ¼, 5/16, and ⅜-inch plates; double butt joints for 7/16, ½, 9/16, ¾, and 13/16-inch plates; and triple butt joints for ⅞, 15/16, and 1-inch plates.

15. Rivets, ⅝ inch in diameter, shall be used for ¼ and 5/16-inch plates; rivets, ¾ inch in diameter for ⅜ to ⅝-inch plates, inclusive; and rivets, ⅞ inch in diameter, for 11/16 to 1-inch plates, inclusive.

16. Plates more than ⅝ inch thick shall be sub-punched and reamed.

17. The minimum thickness of the plates for the cylindrical part shall be ¼ inch. The thickness of the plates in spherical bottoms shall never be less than that of the lower ring in the cylindrical part of the tank.

18. The facilities at the plant where the material is to be fabricated will be investigated before the material is ordered.

19. All plates shall be punched before being bevel-sheared for caulking.

20. Radial sections of sperical bottoms shall be made in duplicates of the number of columns supporting the tank, and shall be reinforced at the lower parts, where holes are made for piping.

21. When the center of the spherical bottom is above the point of connection with the cylindrical part of the tank, there shall be provided a girder at said point of connection to take the horizontal thrust. The horizontal girder may be made in connection with the balcony. This also applies where the tank is supported by inclined columns.

22. The balcony around the tanks shall be 3 ft. wide, with a ¼-in. floor-plate, and shall have a suitable railing, 3 ft. 6 in. high.

23. The upper parts of spherical bottom plates shall always be connected on the inside of the cylindrical section of the tank.

24. In order to avoid eccentric loading on the tower columns, and local stresses in spherical bottoms, the connections between the columns and the sides of the tank shall be made in such a manner that the center of gravity of the column section intersects the center of connection between the spherical bottom and the sides of the tank. Enough rivets shall be provided above this intersection to transmit the total column load.

25. If the tanks are supported on columns riveted directly to the sides, additional material must be provided in the tank plates riveted directly to the columns to take the shear. The shear may be taken by providing thicker tank plates or by reinforcement plates at the column connections, while bending moments shall be taken by upper and lower flange angles. Connections to columns shall be made in such a manner that the efficiency of the tank plates is not less than that of the vertical seams.

26. For high towers, columns shall have a batter of 1 to 12. The height of the tower is understood to be the distance from the top of the masonry to the connection of the spherical bottom, or the flat bottom, with the cylindrical part of the tank.

27. The bottom plates of stand-pipes shall be not less than 5/16 in. thick, and shall be provided with tapped holes, 1¼ in. in diameter, with screw-plugs spaced at 4-ft. centers to allow a filling of cement on top of the masonry, while the bottom part is being erected, in order to secure the proper bearing.

28. Near the bottom of the stand-pipe there shall be provided one 12 by 18-in. manhole of elliptical shape.

29. Near the top of each tank and stand-pipe there shall be provided one Z-bar acting as a support for the painters' trolley and for the stiffening of the tank. The section modulus of the same shall be not less than $D^2/250$, where D is equal to the diameter of the tank, in feet. If the upper part of the tank is held by the roof construction, this may be reduced.

30. On large tanks, circular stiffening angles shall be provided in order to prevent the tank plates from buckling during windstorms. The distance between the angles shall be located by the following formula:

$$d = \sqrt{t\ 900/D}$$

where, d = approximate distance between angles, in feet;
t = thickness of tank plates, in inches.
D = diameter of tank, in feet.

31. The top of the tank will generally be covered with a conical roof of thin plates; and the pitch shall be 1 to 6. For tanks up to 22 ft. in diameter, the roof plates will be assumed to be self-supporting. If the diameter of the tank exceeds 22 ft., angle rafters shall be used to support the roof plates.

Plates of the following thicknesses will be assumed as self-supporting for various diameters:

3/32-in. plate, up to a diameter of 18 ft. 0 in.

⅛-in. plate, up to a diameter of 20 ft. 0 in.

3/16-in. plate, up to a diameter of 22 ft. 0 in.

Rivets in the roof plates shall be from ¼ to 5/16 in. in diameter, and shall be driven cold. These rivets need not be headed with a button set.

32. A trap-door, 2 ft. square, shall be provided in the roof plate. Near the top of the higher tanks, a platform with a railing shall be provided, for the safety of the men operating the trap-door.

33. An ornamental finial shall be provided at the top of the roof.

34. A ladder, 1 ft. 3 in. wide, shall be provided from a point about 8 ft. above the foundation to the top of the tank, and also one on the inside of the tank. Each ladder shall be made of two 2½ by ⅜-in. bars with ¾-in. rungs. On large, high tanks, 30 ft. or more in diameter, a walk shall be provided from the column nearest the ladder to the expansion joint on the inlet pipe.

35. In designing tanks, 6 in. additional height shall be allowed for over-run.

36. The bracing in the towers shall be adjustable.

37. The size of the anchor-bolts shall be determined by the uplift when the tank or stand-pipe is empty. The unit strains in the anchor-bolts shall not exceed 15,000 lb. per sq. in., and the minimum section shall be limited to a diameter of 1¼ in.

38. The concrete shall be assumed to have a weight of 140 lb. per cu. ft., and shall be sufficient in quantity to take the uplift.

39. Any parts of the tank, stand-pipe, or tower, in which difficulties may arise in field riveting, shall be assembled in the shop, and marked properly before shipment.

40. The structural material shall conform to the "General Specifications for Steel Railroad Bridges" by the American Railway Engineering and Maintenance of Way Association.

41. The workmanship shall be in accordance with the Manufacturers' Standard Specifications of February 6th, 1903.

42. Before leaving the shop all work shall be painted with one coat of approved paint, excepting the laps in contact on the tankwork. All parts which will be inaccessible after erection shall be well painted. After erection, the structure shall be covered with one coat of the same paint.

43. Three-ply frost-proof casing shall be provided, if necessary, around the inlet pipe. This casing shall be composed of two layers of 1 by 2½-in. lumber, and each layer shall be covered with tar paper, and one outside layer of ⅞ by 2½-in. dressed and matched flooring. The lumber shall be in lengths of about 12 ft. A 1-in. air space shall be provided between the layers of lumber, and wooden rings or separators shall be nailed to them every 3 ft. The frost casing may be made square or cylindrical.

Development of Water Supply from Limestone

In the July number of MUNICIPAL ENGINEERING, I read the article beginning on page 36, entitled "Yield of Limestone and Sandstone Wells," and was very much interested; and as I have a proposition in limestone, I am taking the liberty of writing you in the hope that you may find time to give me suggestions in the matter.

The proposition is a small lake or pond in limestone, with diameter of about 200 feet and an average depth of about 85 feet. Near one side there is an aperture or hole in the bottom, about 3 feet across, which has been sounded to a depth of over 500 feet without touching bottom; and the lake flows a never failing, or increasing stream which measures 120 miners inches.

Now the point I wish to find out is this, if I should install pumps with sufficient capacity to lower the lake, say 100 feet, and keep the water and pump at this level, how much could I expect the flow to increase? Should it not increase many times? Such, to me, would seem to be the results which should follow, for the reason that it would mean an increase in the head.

I might also mention that this lake is situated on the slope of one of the biggest mountain ranges in Arizona.

Any information or suggestions which you can give me will be greatly appreciated.

B., Prescott, Ariz.

This subject is quite fully treated in Turneaure and Russell's "Public Water Supplies" ($5) and the principles to be followed in estimating the probable flow of wells for various reductions of head are stated and formulae are derived. In general it may be said that the increase in yield is proportional to the increase in head or the increase in depth to which the water is drawn down. In one instance of a deep well a lowering by pumping of the water level 120 feet below the level at which it stood in the well gave a yield of 10.2 cubic feet a minute and a lowering of the level 238 feet produced a yield of 18.8 cubic feet a minute.

If the yield had been exactly proportional it would have been 20.3 cubic feet instead of 18.8.

The case in question seems to be one of overflow from a water-bearing stratum thru a fissure in an impervious stratum above it, or an outcrop of a fissure in the pervious limestone.

Observation of the variations in flow should show whether they have any relation to the local rainfall or whether they depend upon the supply of water from mountains or highlands at greater or less distances. The aid of a geologist familiar with the country would be almost essential in making this study.

Tests of the flow under pumping would give some information and the longer the tests continue the more information will be available if expert observers are employed. It is possible that the pond is not the only point of overflow of the water in the stratum. In that case keeping the water below the point of overflow in the pond would soon develop the fact by showing an increase in yield greater than the increase in depth to which the water is drawn down.

The overflow of water from the pond being continuous, it is evident that there is a source of supply which is reasonably continuous. If the fluctuations in amount of flow are great, the indications are that the reservoir is not of great area. If they are slight it is probable that the reservoir is large in proportion to the amount of water reaching it.

In case the reservoir is small, pumping will soon show tendency to exhaustion of the supply and the yield will decrease at the point the pump is located or the pump must be progressively lowered to follows the lowering water level. If the reservoir is large this process will be slower and, if the supply of water to the reservoir is intermittent, the yield will be somewhat variable, but if the constant amount of water drawn from the well is not greater than the average supply to the reservoir, the water level will not be permanently reduced by pumping, tho it may vary at different seasons.

If it is important not to overestimate the possibilities of the supply, the development should take place slowly until the balance between supply and pumpage is found.

It will, of course, be possible to increase the supply from the pond or well to any desired extent by pumping down, the increase in yield being, as stated, roughly proportional to the increase in head, but if the pumpage is materially greater than the supply, this development will not be permanent, for the reservoir will be exhausted and then the quantity available for pumping will be subject to the irregularities of the supply from the distant sources.

Unless the development is required for temporary purposes, therefore, the pumpage should not exceed the average supply in order to be permanent.

Expert assistance in making these tests and the development will be worth all it costs.

How to Lay Out a Small City Park

Will you kindly recommend to me a work on laying out small city parks, 20 to 30 acres? I am on a city civic committee and would like to get the latest information.

B., ———, Tex.

The following books will be of special interest, most of them being new books issued since the present development of interest in city planning and the beautifying of cities:

Nolen's edition of Repton's "Art of Landscape Gardening" ($3.22) is a modern setting of a classic in this field.

Waugh's revision of Kemp's "Landscape Gardening" ($1.50) is a similar modernizing of a standard work.

and Cities" ($3) is devoted mainly to Solataroff's "Shade Trees in Towns street trees, but will be of interest in a study of civic beauty.

Maynard's "Landscape Gardening as Applied to Home Decoration" ($1.50), Parsons' "Landscape Gardening Studies" ($2) and Waugh's "The Landscape Beautiful" ($2) are of more direct application to the development of small areas.

Unwin's "Town Planning in Practice" ($6) is a comprehensive book by an English expert.

Hawkes's "Hints on the Art of Landscape Gardening" is a little book which compels attention and tells where mistakes are made as well as pointing out ways to success.

Mero's "American Playgrounds" ($1.70) treats a subject which should not be forgotten in developing any city park, large or small.

Several civic beauty experts have made reports upon plans for various cities which contain much of direct bearing on a particular case, showing as they do what the existing conditions are and indicating methods of improvement.

Charles Mulford Robinson has put his ideas into two books, "Modern Civic Art" and "The Improvement of Towns and Cities" ($1.25) which treat the subject from all points of view. He has published several reports on improvement of cities, among which the following are at hand: Los Angeles, Cal., Ridgewood, N. J., Oakland, Cal., San Jose, Cal., Denver, Colo., Binghamton, N. Y., Ft. Wayne, Ind., Honolulu, H. I. There are many more. Mr. Robinson was also a member of commissions which prepared plans for Columbus, O., Rochester, N. Y., etc.

John Nolen has put four of his reports

into one book which contains many suggestions applicable under almost any conditions. He also has published a number of separate reports of which that on San Diego is specially comprehensive and beautiful; that on Roanoke, Va., is suggestive for a small city.

Kelsey and Guild made a report on Columbia, S. C.; Carrere and Hastings on Hartford, Conn.; commissions of which D. H. Burnham was an active member, on Washington, Cleveland, Chicago and San Francisco; Olmsted Brothers on Baltimore, Md.; and there are many more of more or less value and interest.

Rates for Fire Hydrants in Gravity Water Supplies

I desire information concerning charges of private water companies to cities for fire plugs per annum and also if 4-inch mains are sufficient fire protection to municipalities. I learn that several water companies charge from $15 to $25 per annum for each fire plug when water is furnished by gravitation entirely. H., ———, Md.

Nearly all the hydrant rentals paid by cities and towns having gravity supplies furnished by companies in the states about Maryland lie between the limits of $15 and $25 a year.

In a list of 75 waterworks in those states, having gravity suplies, nearly all for small cities, towns or boroughs, four pay nothing for fire protection. Many pay a total sum for fire protection and the average per hydrant changes as the number of hydrants changes. Others pay an annual rental per hydrant. Reduced to charge per hydrant per year, which is fairly correct, four towns pay $5 or less, 4 pay $6 to $10, 16 pay $11 to $15, 16 pay $16 to $20, 13 pay $21 to $25, 9 pay $26 to $30, 5 pay $31 to $35 and 6 pay more than $35. There is a little doubling up, for a few cities pay a higher rate for the first few hydrants put in and a lower rate for additional hydrants, and they are counted above for each rate.

Provision for fire protection ordinarily costs less in a gravity system than in a pumping system, but it still costs something, and the amount that it costs can be quite readily determined. This is the only method of determining the amount of hydrant rental which will be fair to company, town, and water consumers, the former of whom is entitled to a fair return on its capital, industry and ability, and the latter are entitled to as reasonable rates as will insure the same. As between the town and the consumer it is evidently not fair that the town should pay nothing for its fire protection, thus leaving the consumers to pay this, in proportion roughly to the water they use, rather than to the value of the property protected. Because one town pays a hydrant rental of $20 is no really good reason why another town under different conditions should pay the same, especially since the real value of the hydrant rental is usually obtained easily, and in view of the modern tendency to fix the charges for water, including hydrant rentals, on the basis of cost and a fair profit, rather than on "what the traffic will bear."

Four-inch pipes are not large enough for reasonable fire protection. But one good fire stream can be taken from a hydrant on a 4-inch main, which would be sufficient for a small fire in a thinly populated residence district and unsatisfactory for anything else. No main intended for fire protection beyond that just stated should be less than 6 inches, and such mains should be in closed circuits with frequent cross lines, so as to bring supplies to hydrants from two or more directions.

In the list of waterworks referred to above the following are in cities of more than 10,00 population: Dubois, Greensburg, Hazleton, Mahanoy City, Scranton, Shamokin, Shenandoah, Pa., and Hagerstown, Md.

Form of Pavement Surface at Street Intersection

Can you tell me where I can find a method of giving the proper shape to the pavement in the immediate vicinity of its intersection with another?

In other words, what form does the proper "contour map" at the pavement intersection assume that seems to be giving the best satisfaction?

If it isn't too much trouble, I would like to know something regarding the practice of different cities in treating this problem, especially when the streets are of unequal widths and intersect at angles other than right angles.

P., City Engineer, ———, Mo.

Theoretically, the cross-section of each street should continue thru the intersection of the two streets as nearly without change as possible, that vehicles can travel as smoothly as possible; the surface of the street should be as nearly level as possible from curb to curb and at the same elevation as the curb in the area traveled by pedestrians, that they may travel across the street with the same smoothness and absence of obstruction that they travel along the sidewalk; and the water should be drained from the area so completely that it will not stand on any part of the intersection. It is evidently impossible to secure all these results in perfection at the same time. The result is compromise, which is further modified by the rates of grade on the streets, the differences of elevation of the opposite sides of the street, the presence or absence of sewers or underground street drains, the amount of storm water probable at the intersec-

tion, the expediency of culverts across the street, etc., so that no two cities have exactly the same general plans and cannot always apply their standard plan to a particular intersection.

In one city custom has fixed the necessity of having no step at the curb for pedestrians and the cross section of the street must be changed so that the street surface is brought up to or near the curb level across the sidewalk of the intersecting street, while in another city the pedestrians are so accustomed to stepping off the curb that any step not higher than an ordinary stair is passed without notice. In the former city a suit for damages might result if a step at the curb caused a fall and in the latter city one might result if the abrupt change in the cross section of the street and the construction of a bridged culvert across the sidewalk caused a fall by an inadvertent step into the end of the culvert or off the end of the bridge. Many of these points are matters of custom and cannot be changed easily.

Flattening the whole intersection for the benefit of the street and sidewalk traffic offers difficulties in drainage which cannot be overcome, so that a third complication is presented.

Assuming a level intersection, familiarity of pedestrians with steps at the curb, and sewers to take the drainage, the simplest case results, for then it is only necessary to ease off the curves of the crowns of the two streets where they intersect, which can be done best by the eye in smoothing off the cushion for a block pavement or the wearing surface for a street pavement. This is ideal for street traffic and drainage, if the sewer inlets are put at the curb intersections, but does nothing for the pedestrian who must step over the water when it is running in the gutter and in any event must step down and up at the curbs and follow the crown up and down in crossing the street between. This can be improved sometimes by flattening the crown slightly where the pedestrians travel and putting in a bridge across the gutter with a slight slope down from the curb, thus keeping the pedestrian out of the water and inserting a very slight obstruction to street traffic by forcing wheels away from the curb at these bridges. Or sewer inlets can be put opposite the end of each property line so that the water will not run across the pedestrian's path, and no other change will be necessary except to deepen the gutter at the inlet and possibly elevate it slightly across the sidewalk so that the water coming down the street will be sure to stop and run into the inlet. In such case care must be taken to give water falling on the street intersection a chance to get to the inlets or special inlets for this water must be provided.

If there is no underground street drainage, a serious complication is introduced. Some cities frankly carry the gutters across the intersecting streets whenever necessary, and every vehicle must slow up to make its bow in running across this gutter, even if the side slopes are made as flat as the necessities of the pedestrians traveling alongside and parallel with it will permit. Others cover these gutters in more or less permanent fashion. This is a difficult matter if the streets are nearly level, but is not so serious if there is considerable slope across an intersection, for then the upper end, at least, of the culvert across the street can be set deep enough to make ample provision for a permanent form of culvert construction.

If the interests of the pedestrians are paramount, the troubles of the engineer increase and the expedients resorted to are almost as numerous as the varieties of form, size, slope and angle of the intersections.

The general rule is to work out as satisfactory a plan as possible, fix and set the curb corners, the center of the intersection and the centers of the streets on the center line of each sidewalk line crossing them, and the location and elevation of each sewer inlet, and then work in the surface of concrete foundation and of wearing layer by eye to make the smoothest and best looking connection of these various points and lines possible in the particular case.

The discussions of the subject in books are not extended. Spalding gives two small pages to street intersections in his "Text-Book on Roads and Pavements," ($2). The rules given by Morrison on one page of his "Highway Engineering" ($2.50) are so seldom applicable as a whole that they serve only as a general indication of the mode of procedure.

Baker gives descriptions and drawings showing methods of making crossings for pedestrians with and without bridges across the gutters, in his "Roads and Pavements" ($5). He calls attention to the resulting difficulties in draining the intersection of the street surfaces, but offers no direct solution. He devotes a half dozen pages to suggestions of methods of solving difficult problems in street intersections where there are considerable differences in elevations and slopes within and adjoining the area of the intersection. Byrne gives some of these suggestions in different form in a couple of pages of his "Highway Construction" ($5).

Blanchard and Drowne's new book on "Highway Engineering ($4.50) devotes about 8 pages to the design of street intersections giving mainly the methods

of design used in New York City. Small cities need not be quite so elaborate in their treatment of the subject. The latest edition of Tillson's "Street Pavements and Paving Materials" ($4) gives the New York method in even more detail in the eleven pages devoted to this subject.

Cost of Various Kinds of Pavement

I would appreciate a comparative estimate of the cost of different kinds of paving material per square yard, including cost of labor in paving. H., Mayor, ———, Tex.

The cost of paving in any particular place depends upon the cost of materials delivered at that place, the wages paid all classes of labor used, the customs followed in letting contracts and doing the work, the methods of paying for the work, whether in cash or orders or bonds general or special, or whether in payments or all at one payment, the discounts on the paper used, etc., and no two cities are exactly alike in all these respects. In making comparisons of the relative cost of two pavements these conditions must also be taken into account and a pavement which is cheapest in one locality may be the most expensive in another. Notwithstanding the great ranges in cost of pavements it is interesting to see how nearly the averages remain the same. It must be remembered, however, that the averages may not be directly applicable in any particular place, and that, for definite reasons the cost at that place may be very different from the average. With this warning the following figures are given as a basis for comparison of the cost of pavements in Texas and states in its neighborhood:

Asphalt pavements cost from $1.90 to $2.50 in the south, with occasional lower prices near sources of asphalt materials and higher prices where freight charges are high. Generally the prices range under ordinary conditions between $1.75 and $2.50, with a few cities under special conditions paying as low as $1.20 to $1.40 and a few where paving materials are high in price running above $3. The median price is about $2.25.

Asphalt block pavements cost from $1.73 per square yard in Savannah, Ga., and $2.10 in Waycross, Ga., to $3.20 in Niagara Falls, N. Y.

Bitulithic pavement costs $2.09 in Ft. Worth and Waco, Tex., and from $1.65 to $2.36 in other southern states. The median price is about $2.10 a square yard.

Brick pavement costs $2.06 in Ft. Worth; $2.20, not including grading, in Houston; $2.25 in Tyler, Tex., and from $1.55 to $2.75 in other southern states, with one pavement on sand foundation at 82 cents. The median price is about $1.75 per square yard.

Concrete pavement costs $1.85 for vitrolithic and $2.06 for Blome pavement in Ft. Worth; $1.85 in Greenville; $1.85 in Hillsboro; $1.40 with bituminous top in Waco; $1.35 for plain 2-course concrete in Wichita Falls, Tex. It ranges from 87 cents to $2.95 in other southern states, the lower prices being usually for forms not patented. Where grading is not included and on country road construction the cost is in some places as low as 75 cents, and Ft. Smith, Ark., which seems to be able to lay all its pavements at record-breaking prices, reports 64 to 75 cents as the cost of 6-inch 1-course concrete pavements. Some of these concrete pavements have a bituminous top and some have steel reinforcement. The median price is about $1.25 a square yard.

Stone block pavements cost $3.95 in New Orleans, La.; $1.75 in LaGrange, and $1.71 in Savannah, Ga. Prices in other cities range from $1.50 to $5.00, much of the variation being due to the differences in distance of the cities from their sources of supply. The median price is about $3.00 per square yard.

Wood block pavements cost $2.70 in Brownsville, Tex.; $2.24 in Shreveport, and $3.00 in New Orleans, La.; $2.40 in Little Rock, Ark.; $2.18 in Albany, and $2.72 in Charleston, S. C.; $2.42 in Greenwood, Miss. The median price is about $2.75 per square yard.

Bituminous macadam surfaces on brokenstone or gravel bases cost about $1.00 to $1.20 a square yard. Bituminous concrete pavements on the same basis cost about $1.40 a square yard.

Incinerating Plants Producing Power

As president of the board of health, I am collecting data for an incinerating plant with an idea of using the by-products and the power energy for electric lighting purposes. Will you kindly advise me who to write to and if you know of any plants now being operated successfully?

Mayor, ———, N. J.

No city in the United States has yet made a successful application of the power developed from an incinerating plant for commercial purposes. Several, like the plant in the Borough of Richmond, New York City, that at Milwaukee, Wis., and that at Westmount, Can., have developed the power necessary to operate the plant. The plant at Milwaukee is reported to have an excess of power and a committee on municipal efficiency has recommended that the necessary machinery be installed for the utilization of this waste power in the generation of electric current. The installation has not yet been made.

There are numerous plants in England utilizing the heat generated in incinerating plants for producing electric current, list of which can be supplied if desired.

Machinery for Oiling Streets

I would like catalogs and information on crude oil spreaders or sprinklers to oil dusty streets; also cost and cheapest way to oil in small towns and cost of suitable oil for such work. J., Idabel, Okla.

The simplest dust-laying treatment of a street or road is sprinkling with crude oil. For this purpose an ordinary sprinkling cart or wagon is used and the oil is applied cold. Better results are obtained with some petroleum residuums and with asphaltic or semi-asphaltic oil emulsions, which can also be applied cold and with an ordinary sprinkling cart if liquid enough. But, the more permanent and valuable petroleum products of the sort require heating and possibly air pressure and special forms of sprinkler apparatus to get them on the road in proper shape and spread them uniformly.

If crude oil or oil residuums are used the asphaltic oils should be used as they have a binding quality which the paraffine oils lack. The latter, therefore, serve only a temporary purpose as dust layers while the former are much more permanent and the frequency of sprinkling is therefore greatly reduced.

The cost depends upon so many strictly local conditions that no definite estimate can be made for a particular case without knowledge of those conditions. Thus a proper oil in Oklahoma may cost say 3 or 4 cents delivered when it might cost 8 or 9 cents or even more on the cars at a point much more distant from sources of supply. Prices of oil are generally increasing each year. The quality of the oil fixes to some extent the amount to be used, and it is better to make several applications of small amounts than one application of a large amount, altho the cost of the several trips over the road with the sprinkler at different times will evidently be greater than that of a single trip distributing the whole amount to be used.

The character of the road surface also affects the amount of oil to be used. Thus a light treatment of a good macadam road may require one-third of a gallon of oil per square yard or less, while a fuller treatment of an earth road may require a gallon and a half or even more per square yard. A macadam surface can be treated with reasonable satisfaction using say a half gallon of oil per square yard if it is evenly distributed and the surface is sprinkled with sand or dust afterward as much as may be necessary to take up any excess of oil which may result from inequalities in the oil distribution.

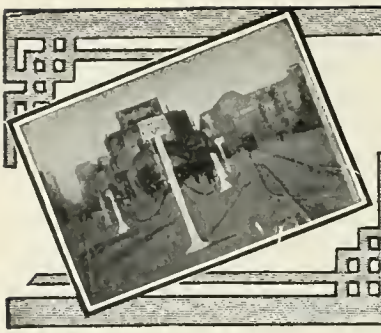
The oil treatment is reported to cost in Washington parks from 1.2 cents per square yard when one-twelfth gallon was used per square yard to 4.6 cents when six-tenths gallon was used. The cost of labor per square yard was 0.8 cent and the cost of oil was 6.5 cents per gallon. Reports indicate that the average cost of oiling macadam roads lies between these limits.

Sprayers for oil and tar can be obtained from the following manufacturers: Wm. F. Irish, 17 Battery Place, New York City, the Johnston oil and tar sprayer; Austin Western Road Machinery Co., Chicago, Ill.; Studebaker Corporation, South Bend, Ind.; Kindling Machinery Co., Milwaukee, Wis.; E. D. Etnyre & Co., Oregon, Ill.; Port Huron Engine & Thresher Co., Port Huron, Mich. Consult the firms listed each month in the Business Directory of MUNICIPAL ENGINEERING under the headings Calcium Chloride, Chloride of Lime, Dust Laying Compound, Heating Wagons Oil and Tar, Johnson Sprayers, Motor Truck Oilers, Motor Truck Street Sprinklers, Road Binder, Road Machinery, Road Oils, Road Oilers Horse Drawn, Road Scarifiers, Scarifiers, Scrapers, Sprayers, Sprinklers, Street Sprinklers Horse Drawn, Tank Wagons, for machinery and materials of use in such work. All the firms named will send catalogs on request.

Cement Sampler

We would thank you if you would tell us who manufacture cement samplers for obtaining samples from the center of a barrel. H., Chicago, Ill.

Grain or flour samples should be suitable for the purpose. In Chicago they can be obtained of H. W. Caldwell & Son Co., 17th and Western Ave., and Moore & Lorenz Co., 814 Fulton St. Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.; Tinus Olsen & Co., 500 N. 12th St., Philadelphia, Pa., and Riehle Bros. Testing Machine Co., 1424 N. 9th St., Philadelphia, Pa., can supply them.



WORKERS IN THE FIELD

Smoke Abatement Ordinances

The Editor of Municipal Engineering:

Sir—In popular discussions of the smoke problem attention is frequently called to the "enormous losses" resulting from the failure to burn the solid carbon particles that pass out of the stack in smoke. If this were the only, or even the greatest, loss attributable to smoke emission, the need of the smoke abatement would concern only those using a given fuel and might be overlooked, inasmuch as the heating value of the carbon escaping as solid particles represents only 1 to 3 per cent. of the total heat units in the coal used. There are, however, other and greater losses from the partial burning of carbon to carbon monoxide (CO) and from the escape of unburned hydrogen and hydrocarbons. Under some conditions of furnace design the latter losses may amount to 20 per cent. of the heating value of coal.

When furnaces are operating under smoke-producing condition, not only is fuel wasted but the damage resulting from the effects of the smoke is enormous and affects the public directly. It has been estimated that in Cleveland, Ohio, this damage amounts to $12 per capita per annum. In Chicago the damage has been estimated to equal four-fifths of all the taxes levied for municipal purposes, or a sum equivalent to at least 80 per cent. of the cost of all the coal burned. Among the many ways in which this damage makes itself felt are: By increased expenditures for repairing and repainting exteriors and interiors of buildings, for artificial light made necessary by the decreased amount of sunlight, for laundering and cleaning, and by injury to vegetation.

The Bureau of Mines recently sent out inquiries to the officials of the principal cities of the United States soliciting information concerning the smoke conditions in the various municipalities. In studying the data thus obtained the cities were divided, according to population, into the three following classes: First, cities having less than 50,000 inhabitants; second, cities with 50,000 to 200,000 inhabitants, and, third, cities of over 200,000 inhabitants.

The data showed that out of approximately 240 cities in the first group 12 reported having either a smoke ordinance or an official charged with smoke inspection. From the second group, about 60 replies were received and of the cities represented by them, 17 are making more or less vigorous efforts to suppress the nuisance. Of the 17 cities mentioned, the most attractive are Des Moines, Ia.; Lowell, Mass.; Syracuse, N. Y.; Toledo, Ohio; Richmond, Va., and Atlanta, Ga. Of the 28 cities having over 200,000 population, 5 are making practically no effort toward smoke abatement, but in three of these fuel oil is used almost exclusively, and the smoke problem is not serious.

Among these cities, three of them, Denver, Detroit and St. Louis, have smoke ordinances merely to prohibit the emission of smoke within certain limits, but provide a clause designed to protect the rights of the infringer of the ordinance. Buffalo has a similar ordinance, but of such a drastic nature that its effectiveness is largely vitiated. Newark, likewise, has a prohibiting ordinance with a clause giving immunity for a certain time, thus permitting changes in plants where required. New York prohibits smoke emission and prescribes penalties, but does not supervise the design of new plants.

The smoke department of the city of Chicago is holding every new plant in the city to a standard of 2 per cent. smoke density on 10 hours observation before issuing a certificate of operation, as provided for in the ordinance. That this standard is not unreasonable, even in the hand-fired installations, may be realized when it is stated that with approximately 250 new plants which have been installed under permit since January 1, 1912, practically all of them that have been put in operation are able to show this low density on a Ringlemann chart. Those which do not show this density are studied with a view to improving conditions, and no certificate of

operation is issued until this standard is reached. For the purpose of keeping track of this work, a form of certificates of operation release has been prepared. This certificate, after giving the type of boiler and furnace, provides for a statement by the engineer of the district that he has personally seen the furnaces in operation, carrying their regular working load, and that he knows personally that the plant can be operated inside the ordinance. To this form is attached a Ringlemann chart reading showing a day's observation with 3 per cent. density or less; the certificate is then issued, a copy of the Ringlemann chart going to the plant owner with a statement that this is the standard which the smoke department will expect the plain to maintain in the future. As the Ringlemann chart is taken with the full knowledge of the operators, it really sets a mark for them to maintain, and any deviation from it is quickly noticed by the smoke department and followed up until the plant is clean at all times.

During the past few years we have installed steam blast heating and ventilating systems in hundreds of public school buildings in Michigan, Indiana, Ohio, and other central western states and in the majority of these instances have installed a type of boiler having a double grate construction which permits the infusion of a sufficient supply of heated oxygen into the combustion chamber, which oxygen unites with the fuel, giving combustion of gases which might otherwise escape. The hot gases also have a long travel, as they pass thru the tubes in the boiler, then entirely around the boiler, before making their exit in the breeching. This type is familiarly known as the Kewanee and possesses a very low water line. This type of boiler is working under varying pressure ranging from 5 to 40 pounds, with minimum of smoke exhaustion when properly fired.

J. W. Bryce,
Bryce Heating and Ventilating Co.,
Toledo, O.

Comparative Street Cleaning Costs

The Editor of Municipal Engineering:

Sir—During the past year an average of 188 laborers were employed in cleaning the streets of the city. The force was divided into two shifts, a day and a night shift. The night shift consisted on an average of 80 men, and was detailed to clean the hard surface streets in the business district. Of the night shift 74 men operated 12 power brooms, 4 sprinklers and 24 carts and cleaned 742,000 square yards (35 lineal miles) per night at a cost of 27 cents per 100 square yards or $5.81 per mile. The remaining 13 men on the night shift operated 6 flushing machines, and cleaned 169,600 square yards (8 lineal miles) per night at a cost of 21 cents per 1,000 square yards or $4.47 per lineal mile. The total cost of cleaning by night was $73,890 of which $5,000 was for the flushing gang and $68,890 for the other gang.

The day shift consisted of 101 men, detailed as follows: 26 men who operated five power brooms, two sprinklers and ten carts, for cleaning hard surface streets in the outlying districts. They cleaned an average of 275,600 square yards (13 lineal miles) per day, at a cost of 25½ cents per 1,000 square yards, or $5.50 per lineal mile; total cost for the year, $22,000.

Twelve men, who operated six tank flushing machines for cleaning hard surface streets in the residence district, cleaned an average of 212,000 square yards (10 lineal miles) per day, at a cost of 18 cents per 1,000 square yards, or $3.85 per lineal mile; total cost for the year $11,000.

Three men and one horse, who operated one hose flusher for cleaning hard surface streets in outlying districts, cleaned an average of 26,500 square yards (1¼ lineal miles) per day at a cost of 31 cents per 1,000 square yards, or $6.50 per lineal mile; total cost for year $2,500.

Eleven men, each with a patrol cart and one man with a horse and cart were employed at cleaning up horse droppings from hard surface streets in the business section. Each patrol cart kept eleven blocks clean; total cost for year $10,000.

Twenty-three men and fourteen carts cleaned and carted away the dirt from macadam and gravel streets. They cleaned an average of ¾ mile per day at a cost of $77 per mile. Total cost for year $15,250. As there are 140 miles of this class of improvement in the city, it takes the present force 187 days to cover this distance once.

We also operate two Kindling squeegee machines which have been giving excellent service, each machine averaging 74,200 square yards per working day of 8 hours and at a cost of 11 cents per 1,000 square yards. It should be understood that these machines thoroly sprinkle and clean in one operation, removing on the average of 4 cubic yards of filth per 1,000 square yards of pavement cleaned.

T. M. Hurlburt,
City Engineer, Portland, Ore.

Negro Segregation Ordinances

The Editor of Municipal Engineering:

Sir—As to the legality of negro segregation ordinances, there is a good summary of this matter in the *National Municipal Review* for April, 1912, and from

this article we are led to believe that ordinances passed in Richmond and Ashland, Va., may have stood the test.

A report on this matter was recently made in St. Louis by the Civic League, which is unfavorable to any such segregation, and endeavors to show that it would always be unconstitutional.

ANDREW LINN BOSTWICK,
Municipal Reference Librarian,
St. Louis, Mo.

Following is an abstract of the proposed ordinance and of the report upon it referred to by Mr. Bostwick:

The proposed ordinance provides in its first section that no white person shall move into a block, a majority of which is occupied by negroes; in its second section that no colored person shall move into a "white" block; and in its third section excepting domestic servants residing in the houses in which they are employed.

The report states that a similar ordinance in force in Baltimore is under test in the courts and an adverse decision is expected. The arrests under the ordinance have been of 28 whites and 6 negroes and the enforcement of the ordinance is expected to die out if the ordinance is not killed by the courts. Two earlier ordinances were declared unconstitutional. Richmond, Norfolk, and Ashland, Va., Winston-Salem, N. C., and Greenville, S. C., have ordinances excluding colored people from certain streets or blocks. Atlanta has a voluntary agreement.

There is little trouble in northern cities, altho sentiment and clannish feeling tend to restrict the colored population to certain rather loosely defined districts or to the alleys, and there is little trouble in southern cities so long as colored people keep to the alleys and their own streets. The troubles arise in what the report styles border cities where the conditions and sentiments are mixed. When the general sentiment and opinion of the community is strongly in one direction that line is followed and, except in cases of very flagrant injustice, no difficulties arise.

Cost of Re-Cut Granite Block Pavement

The Editor of MUNICIPAL ENGINEERING:

Sir—Following is a statement of the cost of re-cutting 12 by 4 by 8-inch old granite blocks to 6 by 4 by 4-inch new blocks, dressing and laying them into 4 inches of moist 1-3-6 portland cement concrete, with 1-2 portland cement grout joints and surface plaster:

200 Square Yards Area.	Unit Cost.	Total Cost.	Cost per Sq. Yd.
204 hours cutting and dressing	$0.625	$127.50	$0.63750
90 hours paving	.625	56.25	.28125
68 hours assisting foreman	.4375	29.75	.14875
24 hours teaming	.625	18.00	.09000
6 hours teaming	.500	18.00	.09000
323 hours unskilled labor	.28125	90.85	.45425
25 bbls. portland cement	1.24	31.00	.15500
8 loads concrete sand	1.00	8.00	.04000
12 cu. yds. crushed stone	1.75	21.00	.10500
		$382.35	$1.91175

Note that the rates of labor are as follows per day of 8 hours:

Assistant foreman	$3.50
Granite block cutters	5.00
Granite block pavers	5.00
Laborers, unskilled	2.25
Teams, wagon and driver	5.00
Horse, wagon and driver	4.00

The above paving work was laid on Lower State street, at the west approach to the Erie Canal bridge, one-half, or about 100 square yards, at a time, and under trying traffic conditions that made it more expensive than it otherwise would have been.

This work was done by direct city employment.

C. A. MULLEN,
Superintendent of Public Works,
Schenectady, N. Y.

ROADS AND PAVEMENTS

Development and Maintenance of Highways in Allegheny County, Pennsylvania

By John S. Gillespie, Road Commissioner, Pittsburg, before the American Highway Association.

The surface of Allegheny county, Pa., is undulating and near the large streams hilly. The lands are fertile and make excellent farms. The great wealth of the county lies in its immense mineral resources. Bituminous coal of the finest quality abouuds, varying in thickness from 5½ to 8½ feet. It is so situated that all its main roads lead to Pittsburg which is in the center. These main roads lead to the outer borders of the county, connecting up with Butler, New Castle, Washington, Freeport, etc., with many cross connections. In fact its features resemble a wheel, Pittsburg being the hub.

Good roads evidently were given careful consideration in years gone by, as shown by data on old turn pikes and toll roads, which were largely planked roads, having a plank roadway 8 feet in width with an earthen or summer road alongside. There are several miles of such roads still in our county, now dedicated to the public.

The road department of Allegheny county was created under the Flinn road act of 1895. This act was effective until May 11, 1911, when a new act was approved providing for the improvement of routes through cities and boroughs, thereby connecting up with the road system in general as laid out by the county commissioners. This new act also increased the bonding power of the county for road improvement, allowing the issuance of two per cent. of the assessed valuation, without being compelled to submit the matter to a referendum, the possible bond issue amounting to $22,000,000.

The present commissioners of Allegheny county are Irvin K. Campbell, J. Denny O'Neil and Stephen J. Toole, now in their second term.

The road department commenced building roads in August 1897. We first started by building roads with telford foundation 8 inches in depth and macadam wearing surface 4 inches thick. Our roads are all graded 30 feet wide, and in the majority of cases, the improved portion is constructed 16 feet in width. In a few cases we only improve 14 feet.

Up to the end of 1905 we had 153.7 miles of macadam road, today we have 437 miles of improved roads of various kinds complete and under construction. Aside from this there are 22 miles of plank road. The two remaining planked roads, however, have been taken over by the highway department of Pennsylvania, being a part of the famous Sproul system. Portions of these planked roads have been improved with brick and asphalt-macadam construction, and it will be but a short time until they are a thing of the past.

Under the acts already mentioned, the county of Allegheny, up to the end of 1912 issued $10,250,000 in road bonds. A road tax varying from 2/10 of a mill (this being the tax levy in 1902) to ¾ of a mill (the present tax levy), has yielded $4,449,040.90, this having been applied to maintenance and sinking fund charges. The sinking fund charges from 1902 to 1912 amount to $3,904,791.10 leaving $10,794,249.80 as a net amount for road purposes.

At the time we commenced building macadam roads, they were considered the "ideal roads." Conditions alter cases, however, and with the advent of the automobile, the heavy truck, and continued use of narrow tires, it was readily seen that a more substantial road would have to be considered. Narrow tires play an important part in the ruination of a macadam road. Our roads we think are constructed right, the best of material obtainable is used for the surface and still the macadam road cuts into ruts. Our board of commissioners at once realized that a more durable road would have to be adopted, so in 1909, after a careful investigation of roads in and thru the eastern states,

they awarded contracts for the first asphaltic concrete surfaces in Allegheny county. The ease with which the surface is laid, the slight inconvenience afforded the traveling public and the fact that it is a dustless road convinced the commissioners and the public in general that it was a step in the right direction. Since constructing the first asphaltic concrete roads, our commissioners have received numerous requests for this class of pavement. The roads first treated were those subjected to the heaviest travel, those to Freeport and Steubenville, subject to automobile travel, hauling heavy resurfacing, until the same has thoroly bonded. The bituminous surface makes an ideal road thru villages and residential sections.

The bitulithic pavement is made of crushed stone, sand and asphalt. The stone is mixed in predetermined proportions as regards sizes, to provide for a maximum density and minimum of voids, so that when rolled in place it is nearly as dense as a block of stone. The surface offers as little resistance to traction as asphalt and it is not slippery. The small stone used provides a gritty surface somewhat similar to macadam and

HULTON ROAD, *Allegheny County, Pa., nearly three years old. No maintenance expense as yet.*

building supplies, etc., neither of which has as yet required one penny of cost for maintenance, and both seem to be improving with age.

We feel that we will not be required to do anything in the way of repairs for 8 to 10 years, while the macadam road under our conditions requires resurfacing or top dressing every two or three years at the best. Mud from the side roads is dragged on the roads and remains there until dried out by the sun. The first rain washes the surface of the bituminous road clean. With the hot mixed material no delay is suffered by passing vehicles, the road is at all times open to travel, while the macadam road suffers more or less during the time of affords a secure footing for horses at all times. The application of the seal coat makes the road practically water-proof. It easily supports the passage of high speed vehicles and heavy travel without loosening the bituminous filler and therefore does not affect the stone and no dust comes from the pavement or its material.

In using the term "asphaltic concrete" I wish to make it clear that I do not refer to the form of construction which has been exploited during the past two years and mis-named asphaltic concrete, being merely a sheet asphalt or mortar pavement (less the essential binder course) with a very little (the specifications say "less than 10 per cent.," which

may be none) crushed screenings coarser than ¼-inch size. The presence of this small percentage of fine crushed stone surrounded or floating in mortar, in my opinion, makes the construction weaker than a pure asphaltic mortar without the screenings, for the reason that the tendency of traffic is to dislodge any of the other detached particles of stone which may be near the surface.

The asphaltic concrete of Allegheny county measures well up to the clear concise definition adopted by the American Society of Municipal Improvements for true asphaltic concrete, as follows: "Bituminous concrete is a pavement consisting of a combination of broken stone and sand or fine mineral matter, cemented together with a bituminous cement and which has all the ingredients mechanically mixed before being laid. To be termed a bituminous concrete it must partake of the well-known characteristics of concrete, that is, there must be stone enough in its composition to form an important part thereof and add to its strength and durability; also, there must be enough of the mortar constituent that it, the sand and bituminous cement, may properly support and bond together the largest particles." This differentiation between true and real and the spurious misnamed asphaltic concrete is most important.

The maintenance of the macadam road is expensive in our county. We do not have any local stone that will answer; it is all shipped in by rail. In the majority of cases we have hauls of 4 to 6 and in some cases 8 and 9 miles from the railroad to the road. This material must be handled a couple of times and you can readily appreciate why our macadam roads cost so much.

While we have paid considerable attention to the asphaltic concrete road, asphalt penetration work also was carried on. Various grades of asphalt were used for this work and the roads laid to date all seem to be in excellent condition. Close on to 45 miles of this class of road have been laid. This pavement has been laid on roads that are not subject to as heavy travel as the ones on which we placed asphaltic concrete.

The brick road has not been overloked either. Approximately 42 miles of brick roads have been laid. Probably half this mileage has been laid with the old macadam road as a base. This work is done by the maintenance branch of the road department. Brick construction costs $22,000 to $25,000 per mile, and covers 13 feet 6 inches of brick pavement, two concrete curbs (flush and combination curb and gutter types) with concrete base 5 inches in depth. It also covers grading, drainage, etc. Our grading averages 11,000 to 12,000 cubic yards per mile of road. Many streams are encountered, and the construction of culverts and bridges further adds to the cost.

The surface of the old macadam road is scarified and formed to a true cross section, concrete curbs are built, sand cushion is placed and the bricks are laid. The surface is then grouted with a cement and sand mixture of equal parts. The old macadam base gives us a road much cheaper than with the concrete base and we get a solid foundation. One of the bad features is the grinding off of the brick at the expansion joints alongside the curb and the breaking off and grinding up of the concrete curb.

DAIRY FARM *Road, Allegheny Co., Pa. Third summer, with no maintenance expense.*

Most of the asphaltic concrete roads have been laid over the old macadam after levelling up and scarifying where the contour or depressions are such as to require much regulation of grade. It is my belief, based on our practical experience of 4 years, that this is the most economical and successful method of conserving the macadam on country thorofares on which the automobile traffic has become so great as to make it impracticable and uneconomical to longer maintain the macadam wearing surface.

Where traffic is light and particularly in the outlying sections, macadam surface is still laid. In this year's recon-

struction work by our maintenance department, we are laying about 8 or 9 miles of water-bound macadam. In order to prolong the life of our macadam roads, we have done considerable in the way of experimenting with light and heavy bodied asphalt oils, using screenings and torpedo gravel in connection therewith. The light oils are mostly used for dust-laying purposes. This is an important part of our season's work, and we keep eight tank wagons applying oil, to relieve the people that reside along the macadam roads. We are just about completing our 1913 oiling, and have used over 250,000 gallons of oil.

It is necessary good asphalt be used in the asphaltic concrete roads. On our Freeport road, reconstructed with this kind of surface in 1910, a huge slip occurred this spring, carrying part of our road away with it. From this part we had samples cut which do not show any wear whatever. The asphalt used in its mixture was the best that could be obtained, and in the sample taken up the asphalt still retained plenty of life.

Allegheny county was not only among the first in the matter of road improvement, but at the same time we inaugurated a patrol system which has been in service since the completion of our first roads, and is added to as occasion demands. Today we have 128 caretakers in our endeavor to place a man on each road, that is, on each 4 or 5 miles of road. It is the duty of these men to keep the roads in good shape at all times, so far as minor repairs are concerned. They are required to look after the drains; the earthen road alongside the improved portion must be kept free from grass and weeds; all loose stones must be removed from the road; and they must look after the removal of small slips or slides; also the matter of obstructions, such as telephone and telegraph poles, sewer heads, bridge walls and copings, etc., the same must be whitened or whitewashed. These act as guides to the traveling public and are very much appreciated. They are also required to make detailed report to the department on any accidents that occur.

This description deals entirely with the county roads of Allegheny. We have several miles of road improved by the highway department of Pennsylvania. No aid was extended to the county in its system of roads, but in order to get additional mileage of improved roads, the county has in numerous cases joined with the state in improving state roads within the limits of the county, paying one-eighth and in some cases one-fourth of the total cost.

Paving Construction, Maintenance and Cleaning in St. Paul, Minn.

By J. H. Beck, General Secretary, St. Paul Association of Commerce.

The streets of St. Paul are being put in better condition this year than ever before, and all of the work thus far has been done by the city itself. At the beginning of July, about 400 men were employed in the paving work, twice the number employed in such work last year. The city of St. Paul has gradually built up its equipment for paving and now has a new asphalt plant, four concrete mixers, ten dump wagons, two road rollers, and a quantity of miscellaneous tools.

Since the city began doing its own paving the citizens have manifested a greater and keener interest in the work, and as a result thousands of men who formerly took everything for granted as to paving materials and methods are now pretty thoroly conversant with the latest pav-

PAVING CONSTRUCTION *in St. Paul, Minn.*
Hauling stone.

ing and its advantages over obsolete methods. It has been clearly demonstrated that many economies are effected without detriment to the work, since the city began laying its own pavements.

The work of paving has progressed very rapidly. Inside of one month the city had all its sub-grade removed from Summit avenue; in a little more than another week all the concrete was set in place, the machine moving to Pleasant avenue between Sixth and Ramsey streets.

Having a larger appropriation under the new amendment to the charter, the superintendent of streets has kept the streets of St. Paul in better repair and cleaner this year than ever before. Since early spring 42 teams and nearly 100 men have been at work grading and dragging the dirt streets, 15 road graders and 25 drags being used. The enormous expense of keeping dirt streets in condition for traffic is apparent when it is considered that the work on all such roads has to be done each spring and again after every heavy rain. Even with the best care which can possibly be bestowed upon them, it is impossible to make them satisfactory to the traveling public.

PAVING CONSTRUCTION *in St. Paul, Minn. Excavating with steam shovel.*

PAVING CONSTRUCTION *in St. Paul, Minn. Grading with twelve-horse team.*

Not only are the streets being improved by new pavements and repairs, but they are being kept clean. This is especially true in the business center of the city. There the streets are flushed every night, the department having four flushing machines and two sweepers in operation for 16 hours each day, the work being done by two 8-hour crews. In addition the city has one flusher in reserve which gives opportunity for overhauling and repair work without interfering with the service. In a 16-hour day the flushers clean an average of 94½ blocks. Last year, one hose was used in flushing and the cleaners did well if they got ten blocks in a night. The new equipment and system provide greater efficiency and have proven economical.

PAVING CONSTRUCTION *in St. Paul, Minn. The concrete mixer gang laying pavement foundation.*

Cost of Hauling With Road Roller

By R. G. Griffith, of B. G. Coon Construction Co., Luzerne, Pa.

Grading and road construction work make peculiar demands upon a road roller; call for a machine which has power reserve, which can travel easily over soft ground and loose earth and up and down all kinds of grades, and which is under perfect and instantaneous control of the operator. We have completed several interesting pieces of road grading and train hauling work during the past year in which we used a Huber combination road roller, furnished by the Huber Mfg. Co., Marion, Ohio.

With this outfit, an average of 1,000 cubic yards of earth per day were taken out, using 11 teams and 1½-yard dump wagons and hauling from 1½ to five blocks, or an average of three blocks. An average of 70 to 80 loads per hour was made, and in some instances as many as 45 loads were taken out in 30 minutes. It is stated that if there had been no time lost waiting for teams, 100 loads could have been taken out in an hour. This work was done under seeming great difficulties as the grades on the pitches of some of the hills were 30 per cent. and the traction surface was of a soapy clay nature.

The following data give a concise record of cost of hauling by means of this combination roller as compared with teams. The average length of haul, on which the following figures are based was three miles:

Number of cu. yds. of stone hauled by roller	2,590
Number of cu. yds. of stone hauled by team	3,980
Number of days outfit was on job	120
Number of days outfit hauled (fraction counted as full)	40

Costs.

Cost of roller operator (salary and expense straight time)	$340.00
Cost of fireman (actual time worked)	66.20
Coal, oil and supplies for outfit	181.81
Cost of maintenance of hauling outfit (one-half season)	53.00
Total	$641.01
Total cost per cu. yd. for hauling	$0.247
Actual cost per cu. yd. for team hauling (on same work and same length haul)	.560
Cost of hauling by roller per cu. yd. per mile	.082
Cost of hauling by teams per cu. yd. per mile	.186

Detailed Cost of Roller Hauling per Cu. Yd. per Mile.

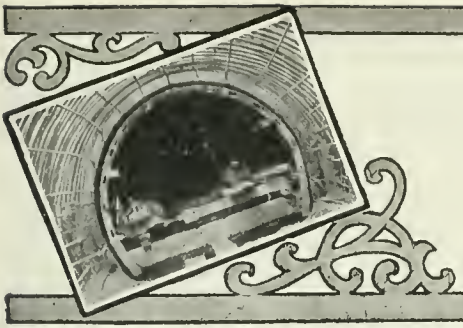
Operator	$0.043
Fireman	.008
Coal, oil, etc	.024
Maintenance	.007
Total	$0.082

That the work of a combination roller need not be confined to rolling, hauling, and stationary plant operation, can best be illustrated by the fact that we also used our machine for pulling small trees without the aid of falls or snatch blocks. One end of the chain was attached to the draw bar of the engine by means of a clevis, and the other end was given one and one-half turns around the tree to be pulled, and the end of the chain made fast with a grab hook. The first trees attempted were about 3 inches in diameter, of persimmon, elm and black jack, all well rooted. Taken one at a time, they pulled out without great difficulty. We next tried the experiment of pulling trees with one hitch by taking two turns of the chain about the first tree and leading the chain back to a second. This proved feasible, and the plan was extended as experience was gained to as many hitches as were permitted by the length of chain available, when the trees were not too large.

For the larger trees, 4 to 8 inches, a single pull to each tree was taken. We quickly learned to make the hitch as high above the ground as practicable, and a block of wood 8 to 10 inches in diameter by 4 feet long was thrown on the ground against the tree and directly under and at right angles to the chain. This bearing acted as a fulcrum when the tree bent over by the pull, and served to bring a very powerful pull on the roots remote from the engine. In case of a few 8-inch black locusts, a man stood by the tree with an axe and struck off the roots remote from the engine as the pull indicated their location. This process aided materially. It was found that the most satisfactory results were secured with the larger trees when the hitch was made at a height of from 3 to 5 feet above the ground.

Exemptions from Peddlers' Licenses in Minnesota

The laws of Minnesota provide that any honorably discharged soldier, sailor or marine who served in the Civil war or the Spanish-American war shall be exempt from the license fees required from peddlers. Various Minnesota cities have been troubled with persons claiming to hold such discharges, and the mayor of Blue Earth, H. J. Frundt, warns others that the discharge of Ross H. Dyar does not exempt him from the fees, and the control of the ordinance, because he did not serve in either war.



SANITATION

Sewage Disposal Plant at Springfield, Mo.

The following description of one of the sewage disposal plants at Springfield, Mo., designed and constructed by Alexander Potter, consulting engineer, New York City, is taken from a paper before the American Society of Municipal Improvements and shows some departures from common practice, particularly in such details as the concrete struts thru the tanks; the provision for inducing a vertical circulation in the upper part of the digesting chamber of each tank; the mechanical distribution of sewage over the filters, being the first installation of such machinery in this country; and the concrete channels in the bottom of the filter bed.

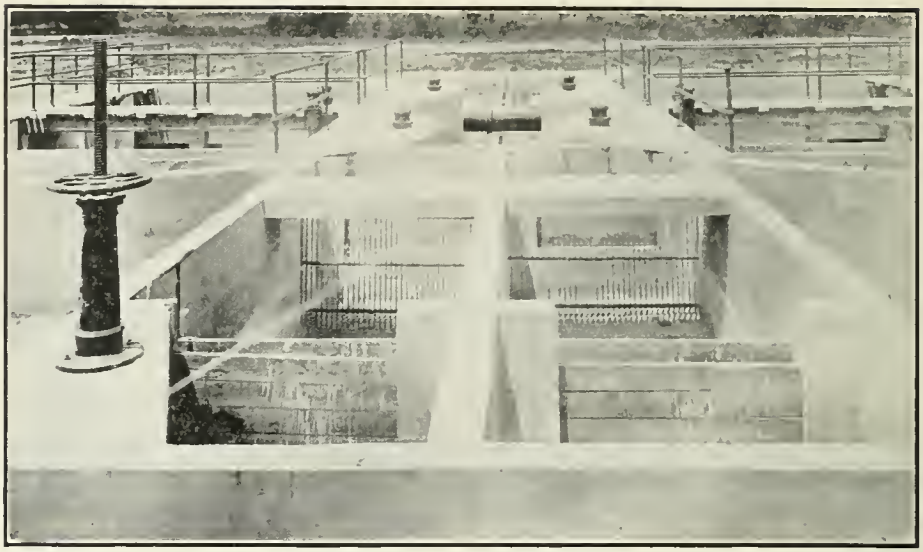
On account of the limited area available it was deemed advisable to use intermittent filters instead of contact beds. The ordinary type of sprinkling filter could not be used, as such a filter requires a head of at least 5 feet to operate the nozzles. Such a head could be obtained only by pumping. Mechanical distribution was therefore recommended. The distributer selected is operated with a head of only 12 inches.

The plant as built consists of a grit chamber built in duplicate, two settling tanks of the two-story type, a sprinkling filter divided into six units, each 53 feet 9 inches wide and 200 feet long, a sludge bed 0.35 acre in extent, and a final settling basin of 150,000 gallons capacity, located at the outlet, 3,600 feet from the remainder of the sewage disposal plant.

The grit chamber is constructed in duplicate. The flow in the grit chamber is retarded sufficiently to retain only the suspended mineral solids which would interfere with the operation of the settling tanks. Provision is made so that during times of flood the back pressure on the outfall sewer can be readily and quickly relieved, thus scouring out whatever deposits may have formed in the 36-inch reinforced concrete pipe.

Concrete, either plain or reinforced, is practically the only structural material available for constructing sewage settling tanks of the dimensions required for a large municipality. So far as the writer knows, the circular tank has been used in this country only in constructing the smaller units; for the larger sizes it has been customary to use rectangular construction. The rectangular form under all conditions, and especially when a large portion of the tank is above the surface of the ground, is a more expensive form to build. The Springfield sewage tanks are neither square nor truly circular. Each unit is four-leaf clover shaped, consisting as it does of four semi-cylindrical segments 26 feet in diameter. This type of construction is peculiarly well fitted not only to resist the

SPRINGFIELD, MO., *Sewage disposal plant; filter bed ready for filling with broken stone.*



SPRINGFIELD, MO., *sewage disposal plant. Completed grit chamber, with settling tanks on either side.*

water pressure from within, but also the earth pressure from without when the tank is below the ground and empty. The shell of the semi-circular segments is 12 inches thick, reinforced vertically with ¾-inch bars spaced 3 feet centers and circumferentially with ¾-inch square bars spaced so that the unit stress does not exceed 14,000 pounds per square inch. The unbalanced tension at the point where the semi-circular segments intersect is taken up by 1¼-inch circular rods embedded in concrete struts.

The steel reinforcement in these ties is designed to resist the tensile forces at the same unit stress as the circumferential reinforcement in the shell. If this is not done, and different stresses are used for the tie rods than are used for the shell, the shell, instead of being subjected to simple tension, will be subjected to bending. The tie rods are fastened to a steel plate 8 inches wide, ⅞-inch thick, bent to a 5-inch radius. By means of double nuts the reinforcement is kept in accurate alinement which insures equal distribution of the tension among the larger number of the tie rods.

The cylindrical segment must be free to expand in all directions. If the expansion is in any way prevented by interior construction, such as the troughs, false bottoms, beams, etc., the shell, instead of being under tension only as contemplated by the designer, will be subjected to heavy bending, often sufficient to cause the fracture of the structure. To permit of the free expansion of the shell when under internal pressure, all interior construction, except at the intersection of the ties and struts with the shell, is separated from the shell by expansion joints.

After passing thru the grit chamber, the sewage enters the distributing trough, which is 2 feet wide, and holds, under normal conditions, about 2 feet of liquid. Eight 8-inch circular openings, placed in the sides of the trough near the bottom and on the side next the outer wall, admit the sewage to the settling compartment. At the end of the trough is an additional opening, placed so as to be but half submerged, so that whatever scum may tend to collect in the distributing troughs is carried over into the settling compartments. Each settling compartment has a capacity of 111,000 gallons, which gives an average period of retention of 1.4 hours when the plant is operated at 4,000,000 gallons, its capacity. The flow in the settling compartment is parallel to the direction of the slot. To prevent eddies and other disturbances from being set up in the settling compartment which might interfere with the settling efficiency, the liquid is admitted to the settling compartment in a direction opposite to that which it must take in passing thru the compartment. The clarified sewage leaves the settling compartment over eight 15-inch weirs discharging into the collecting trough.

The presence of the concrete struts in the settling compartment does not in any way interfere with the efficiency of the tank. Where necessary, they can be

capped with wedge-shaped pieces of concrete having slopes of at least 45 degrees.

In that circular segmental area between the distributing trough and the shell of the tank, all of the floating matter is collected and forms a very heavy scum, requiring slight attention from the operator.

To increase the settling efficiency of tanks of the type described, the writer uses vertical circulation. The amount of sewage thus circulated is very small and does not exceed two per cent. of the total amount of the sewage treated. To accomplish the vertical circulation mentioned, a 6-inch cast iron main with four 4-inch circular openings is laid in the digesting chamber of each tank, about 6 feet above the slot. This circulating main terminates in a small chamber located in the segment between the collecting trough and the shell, which chamber has an adjustable weir to control the flow from the digesting chamber into the collecting trough. In the Springfield plant the liquid thus drawn off is mixed with the effluent from the settling compartment and the resultant mixture is treated on the sprinkling filters. In other plants that the writer has built, the liquid drawn off from the digesting chambers is returned to the distributing troughs. Circulation such as that used in Springfield is especially of value when the sewage to be treated reaches the plant in a more or less septic condition. The Springfield plant has not been in operation long enough to determine the exact value of the circulation system.

The suspended organic and mineral matter which settles out of the sewage in the settling compartment, slides down the inclined plane thru the 8-inch slots located in the bottom of the wedge-shape settling compartments into the sludge digesting chamber. The sludge digesting chamber has a capacity of 105,000 gallons below the opening. The bottom of this compartment is formed by four cone-shaped depressions in which the decomposed sludge ultimately collects. To draw off the sludge, 8-inch cast iron sludge pipes extend down into these cone-shaped depressions, the sides of which slope at an angle of 30 degrees. The lower ends of these pipes terminate in bell-mouths supported on spiders. The sludge pipes are carried up inside of the tank to the top, giving ready access for cleaning. The sludge outlets, of which there are four for each unit, discharge under a 5-foot head into a reinforced concrete trough which conveys the sludge to the drying beds. The open channel used for conveying the sludge is preferable to the closed pipes generally used. In an open channel the sludge drawn off is at all times visible to the operator, and therefore the character of the sludge drawn off can be controlled far better than when a closed sludge conveyor is used. There is positively no odor during the operation of the sludge valves, either in the trough or upon the sludge beds.

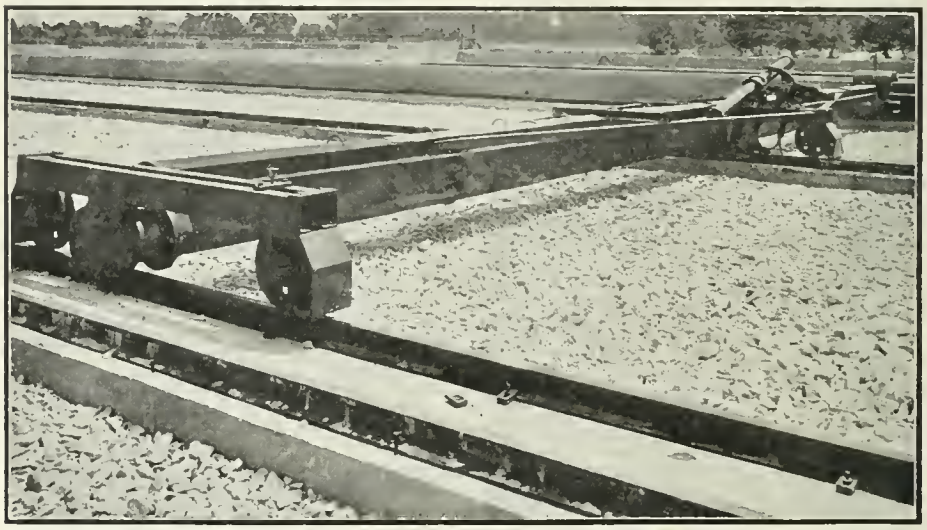
To reduce the loss of head to a minimum power driven mechanical distributers are used to distribute the sewage on the filters. These distributers were

SETTLING TANKS *under construction, showing the reinforced concrete streets, acting also as tie rods to take strains from the lobe-shaped walls.*

manufactured by the Ham Baker Company of London, England. They are designed to distribute the sewage upon the beds with a loss of head not to exceed 12 inches when the liquid is applied at the maximum rate of 720 gallons per square yard per day. Each distributer is supported on three rails, spaced 25 feet on centers. The length of the travel is 200 feet.

The effluent from the settling tanks is conveyed by a 24-inch reinforced concrete pipe to a main distributing trough located at the north end of the filters. The lateral distributing troughs which supply the traveling distributers are fed by 3-foot weirs from the main distributer. The object of these weirs is to insure a uniform distribution of the liquid to the distributers. Plate 4 also shows the construction of the sprinkling filters. The depth of the filtering material ranges from 6 feet, 6 inches in the center to 6 feet at the sides. For underdrains instead of using 6-inch channel tile, the contractor was given permission to construct 6-inch semi-circular channels in the concrete floor and cover them with vitrified tile slabs. The main collectors are semi-circular in shape, 18 inches in diameter and of variable depth, the distance between them being about 25 feet. The rails on which the distributers travel are supported by concrete girders carried by piers spaced 12 feet, 5¼-inch centers. The area covered by each distributer is enclosed by an 8-inch concrete wall. The winter temperature of Springfield is sometimes so low that it may be questionable as to whether the traveling distributers can be successfully operated in extreme weather. Should the traveling distributers go out of commission or any of them break down, it is possible to utilize the filters or any unit thereof as a contact bed to be operated by hand, suitable gates being provided for this purpose.

Extending down the center of the filters between two of the traveling distributers is a 3-foot rectangular conduit in which the normal depth of sewage is 16 inches. A cast iron siphon, 24 inches long and 8 inches in width, conveys the liquid from this trough to the distributer. This siphon is provided with a gunmetal air cock and brass air exhaust pump for starting the flow. The siphon discharges into the feed tubes, of which there are two. These feed tubes are made of wrought iron 3/16-inch thick and have an external diameter of 7⅜ inches. The feed tubes are supported at each end and at the center by a cast iron carriage braced together by rolled steel beams so as to form a rigid structure. In each feed tube just above the center are located ⅝ by 4-inch orifices, spaced about 15 inches lengthwise. The even distribution on to the beds is accomplished by a distributing tube 2½ inches in diameter, located between the feed tubes. This distributing tube is built in sections and can be raised or lowered as required to control the flow of sewage upon the beds. The feed tubes are protected with galvanized sheet iron covers provided with hinged access doors. The protection



TRAVELING DISTRIBUTER, *which sprinkles sewage over the bed thru perforated pipes fed from sewage trough at one end. Hauled by rope; motion reversed by "gun" at center of distributer.*

extends to within one inch of the surface of the bed in order to conserve the heat in the sewage as much as possible, especially during the cold weather. It also acts as a preventive of flies. A space is provided between the two channels supporting the feed tubes, which during the cold weather is to be filled with moss, leaves or other insulating material.

Each pair of distributers is operated by an endless wire cable. All three sets of cables are driven by one 6-h.p. Otto gasoline engine, which gives the distributers a speed of 38 feet per minute. The change in direction of the distributers is accomplished by means of a reversing lever.

The distributers have realized every expectation. Less than 2-h.p. is required to drive all six distributers. The writer believes that the distribution of the liquid over the bed is more uniform than can be obtained by the methods now in use in this country. The more uniformly the liquid is distributed upon a filter, the greater the quantity of sewage that can be applied to the filter to obtain the same degree of purification; or, with a given quantity of sewage, the more uniform the distribution, the greater the purification.

To the knowledge of the writer this is the first time that power-driven traveling distributers have been used in this country. The range of temperature at Springfield makes this installation an important one as indicating possible limitations of service in extreme winter weather without covering the filters.

The final settling basin is 150 feet long and 50 feet wide and has a capacity of 150,000 gallons. A reinforced concrete channel admits the sewage to the basin at the upper end and at the lower end a similar channel conveys the settled liquid to the outlet into Wilson creek. It has not been deemed necessary to sterilize the effluent.

The sludge which is drawn off from the main settling tanks is conveyed by a concrete trough laid to a grade of 0.5 per cent. to the sludge beds. The sludge bed, which takes in an area of 0.35 of an acre, is divided by wooden partitions into twelve units, each unit being 25 feet wide and 50 feet long. Each sludge bed is underdrained with graded gravel 18 inches deep at the center and 12 inches deep at the sides. Down the center of each unit extends a 6-inch vitrified underdrain laid with open joints. The surface of the gravel is covered with a thin course of mortar sand to prevent the sludge from working its way into the gravel. The bed is given a slope of 1 inch in 10 feet away from the sludge inlet to assist in the distribution of the sludge over the entire bed.

Following are the latest analyses of samples of the sewage taken at various points in its passage thru the Springfield sewage disposal plant. These have been received since the paper was read from which the above description was abstracted and are of interest as showing the results of the various stages of the treatment. The report of analyses is signed by Harrison Hale, the city chemist of Springfield, Mo.

At the time these samples were taken the plant was operating at the average rate of 3,000,000 gallons a day. The samples were taken as follows: No. 275 from the crude sewage; No. 277 from the effluent of the settling tank; No. 277 from the effluent of the percolating filters; No. 278 from the effluent of the percolating filters after two hours in the final settling basin.

Results of Sewage Treatment in Springfield, Mo.

Laboratory number	272	276	277	278
Organic	107.0	68.4	27.2	15.6
Free Ammonia	16.5	14.0	3.7	2.9
Nitrites	None	None	0.288	0.864
Nitrates	None	None	None	None
Oxygen consumed	59.3	23.8	10.0	14.5
Suspended Matter				
Total	135.0	41.2	9.2	8.8
Volatile	511.0	28.0	6.4	6.0
Fixed	20.0	13.2	2.8	2.8
Dissolved Oxygen	None	Slight trace	Trace	Trace
Temperature deg. F	69	68	67	
Total number of bacteria per cc	9,500,000	6,450,000	1,110,000	360,000
B. coli Communis in 0.0001 cc. approximate per cent. positive samples	100	95	90	65

Lighting

The Municipal Lighting Plant at Seattle, Wash.

By J. D. Ross, Superintendent of Lighting.

For the lighting of the city of Seattle, Wash., a large system has been built, comprising a hydro-electric generating station on the Cedar River, 39 miles outside of the city; two 60,000-volt transmission lines, an auxiliary water-power station in Seattle using water from the city reservoir, and an extensive city distribution system serving approximately 20,000 customers and supplying energy for street lighting. Altho this plant was briefly described in MUNICIPAL ENGINEERING, June, 1913, the information contained in this paper may be of additional interest.

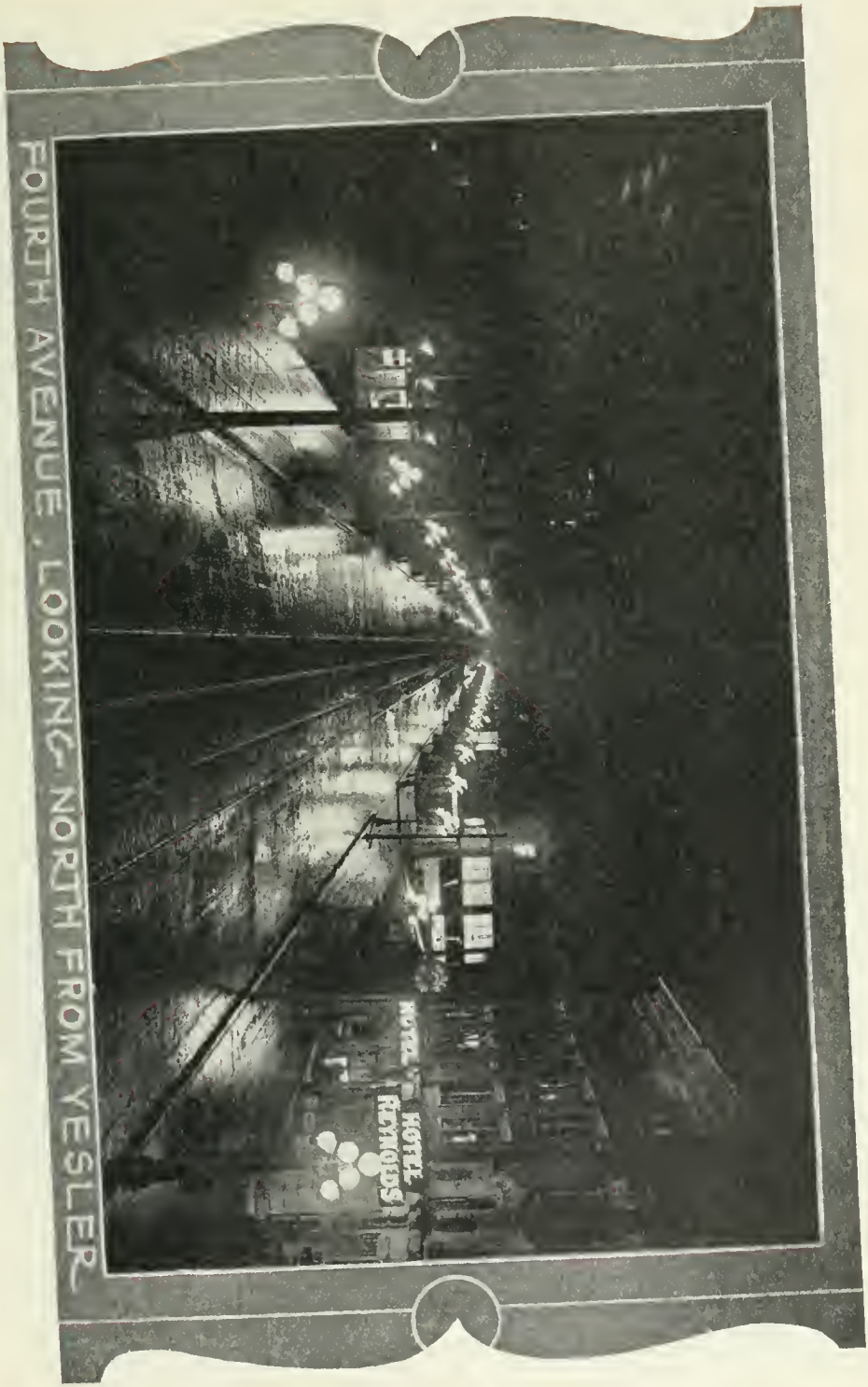
Control of the entire station is brought within the reach of one operator by means of a special control board, 36 inches by 72 inches in size, designed and built by the lighting department. This board contains a diagram of the entire station, gun-metal being used to represent waterwheels and generators; nickel, exciter circuits; brass, the 2,300-volt circuits; and copper, the 60,000-volt circuits. The diagram is so arranged that each operation is seen in miniature on the face of the board, rendering confusion or mistake improbable. The meters and synchroscope are mounted on vertical panels immediately above the control board. As a safeguard in case the load drops off suddenly, three rheostats made of coils of resistance wire immersed in water have been installed, which can be connected to the station bus or to any machine, and thus prevent excessive speeds.

The generating units are placed end to end down the center of the station, with the control board on one side and the 2,300-volt switches on a balcony opposite, together with the field rheostats and switches. For transmission the potential is stepped up to 60,000 volts. There are nine 1,500-k.w. step-up transformers grouped in three banks, connected in delta on the lower tension side and in star on the high tension side, with the neutral point of the star connection grounded. The transformers are placed in a separate building next to the power house, and the high tension wiring is placed in another building, except the line switches, which are in a separate stone building. A duplicate bus system is used thruout on both 2,300-volt and 60,000-volt wiring.

The Fort Wayne step-down transformers are placed on the first floor of the sub-station. There are at present eight of these, each of 1,500-k.w. capacity at 35 degrees C. temperature rise. All are made with a ratio of 54,000 three phase to 15,000 and 2,500 Scott connected two-phase, making four banks of transformers. The secondary coils are connected in series for 15,000 and in multiple for 2,500 volts, two banks being used for each voltage. Under careful test these transformers showed a maximum efficiency of 98.5. The all-day efficiency was found to be 96.6 per cent for 1911.

The distributing system was first designed for three-phase star connection, but as there were two large companies in the city, both operating two-phase, the plans were changed to make it possible to interchange motors without special transformers.

The series street lighting comprises 683 miles of No. 6 wire divided into 29 circuits, lighting 601 miles of streets. The circuits are connected two in series 6.6 ampere 100-light air-cooled Fort Wayne constant circuit transformers. Each of these is equipped on the primary side with a small solenoid-operated oil switch made by the department, and with a test board with plug switches. This arrangement keeps all pressure above 125 volts away from the switchboard. The voltage on the circuit varies with the number and kind of lamps from 2,500 volts to 500 volts. In all there are 692 6.6-ampere arc lamps, 5,315 40-c. p. tungsten lamps, and 199 300-c. p. tungsten lamps. The large tungsten lamps were manufactured especially for the department by the


HOTEL REYNOLDS
FOURTH AVENUE, LOOKING NORTH FROM YESLER

General Electric Company. They have proved satisfactory in every respect, giving steadier, better distributed light and averaging over 2,000 hours of life. The 40-c. p. tungstens are mounted by "goose necks" on the line poles. This type of lamp is ideal for its purpose, since it gives light in small units at a minimum cost for maintenance and power.

The test of the series lighting circuits shows an all-day efficiency for 1911 of 86.3 per cent. from the switchboard to the lamp. The loss in the transformers was 5.0 per cent., and in the line 8.7 per cent.

Seattle's cluster lighting system is one of the finest in existence and is generally admired by tourists and visitors from all parts of the country. The main business avenues are lighted by five-lamp poles, placed opposite each other at the curb line and spaced 80 and 90 feet. The usual design of a five-lamp pole places four globes in the form of a cross, with one center top globe. The Seattle poles, however, have lumination is sufficient, three-globe poles are used, similar to the five-globe poles with the two lower globes omitted. In the parks and along the driveways a single 20-inch globe, with a 75-watt 12½-volt lamp is used. Altogether, there are 1,116 five-ball poles lighting 13.5 miles of streets, 378 three-ball poles lighting 8.5 miles, and 137 one-ball poles lighting 3 miles of street, making a total of 1,631 poles lighting 25 miles of street.

In the business district the system is fed from the underground mains placed near the curb line. The main feeders are placed in vitrified clay ducts with the commercial feeders, and the branches are run in fibre conduit cased with concrete. An exception to this is made when the ducts run under the walk where a basement is to be excavated. In these places steel conduit is used, placed just beneath the sidewalk. Manholes for transformers are placed below the sidewalk at street corners, about three blocks apart. Five, ten

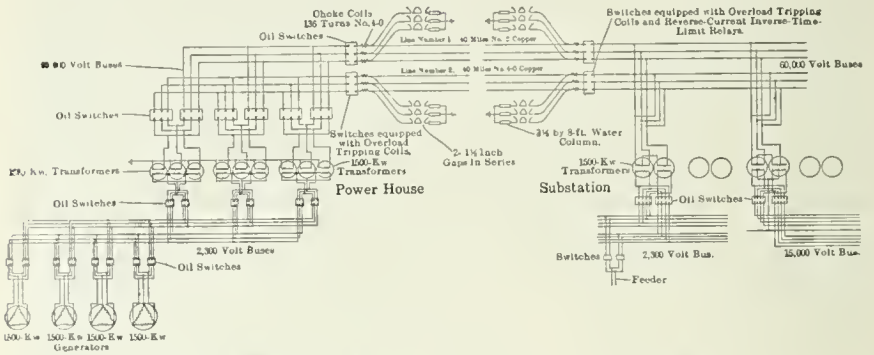


DIAGRAM *of connections on special control board.*

the lamps placed in a triangle perpendicular to the sidewalk, with a 16-inch globe at the top, two 14-inch below and two 12-inch globes, turned downward, at the base of the triangle. All the globes have a light sand-blast finish. This design gives a beautiful festoon of decorative lights along the sidewalks, and at the same time secures a uniform illumination on all parts of the street. The intensity on the sidewalk carries from 0.32 to 0.79 foot-candles, and at the center of the street from 0.34 to 0.45 foot-candles. This illumination, which is ample, is produced by using 50-watt tungsten lamps fed from the small transformers in the pole base at a pressure of 8 volts. This type of lamp was designed by the General Electric Company especially for the lighting department and has proved so satisfactory that it has since been made standard by that company. The average life of this lamp has proved to be over 2,000 hours.

In residence districts, where lower il- and fifteen kilowatt transformers are used, all on one street being alike. These transformers are connected to feed both ways from the manhole, the lamps in each section of street being fed from one secondary coil of each adjacent transformer. A three-wire lead-covered secondary cable is used, so connected that the blowing of a fuse will leave each alternate pole dark, and so leave the street fairly well lighted. The secondary voltage is 120-240 stepped down to 8 volts by the pole base transformers.

A municipal plant must adhere to uniform rates at all distances from the station much more closely than a private concern, altho the cost of current delivered in distant suburbs is greater; the question of cheap transmission to suburbs has therefore been carefully studied. The economic distance to which 2,500 volts could be carried was computed from the cost of material and labor, interest on bonds, and net value of current per k.w.

per annum, and beyond the economic distance sub-stations were installed with supplies at 15,000 volts and distribution at 2,500 volts, giving better economy and regulation. One of these at Fremont, distant 19,200 feet from the substation, has a capacity of 1,500 k.w. at 40 degrees C. temperature rise. Another at West Seattle, 26,000 feet distant from the sub-station, has a capacity of 500 k.w. at the same rating. A similar substation has been completed at Hillman and a site purchased for one at Ballard. For mechanical reasons No. 2 is the smallest wire used for the 15,000-volt transmission. These lines travel largely along the water front on Puget Sound, where the new canal will bring a considerable number of industries. In all, these lines traverse 10.7 miles of water front and will eventually follow the entire water front of both salt and fresh water.

It is obvious that some system would be ideal that would supply all large industries from the 15,000-volt lines direct, leaving only the lighting of the suburbs beyond to be handled by the sub-stations, thereby requiring much smaller transformers and giving vastly better regulation. It was also desired to use pole-type transformers except for very large loads. A three-phase star system was the nearest approach to the ideal then in use and a system was therefore designed for the purpose, using a two-phase 15,000-volt system, the center point of each transformer being brought out and connected to a fifth wire which was grounded frequently along the line. This system gives in reality four circuits for the two phases. Power is transmitted at 15,000 volts, but is distributed along the line for large power and lighting loads at 7,500 volts, stepping to the supply voltage desired. To this end 7,500-volt transformers the placed on poles in the usual way and connected from the outside wire of a phase to a neutral wire, as in the ordinary three-wire system. Submarine cables have 15,000 volts between wires but only 7,500 volts to lead sheath. This system has given entire satisfaction and makes sub-station work easier by eliminating large power loads from the automatic regulators.

PROGRESS IN PUBLIC LIGHTING

During the past year the science of illumination has probably made greater progress than at any other similar period of its history. While few radical changes or developments have been made in connection with light sources, improvements have been made in mechanical construction of present systems, resulting in increased efficiency, and illumination has become the subject of study by physicists, oculists, architects, legislative bodies and others as never before. The progress in public lighting reported by a committee of the Illuminating Engineering Society is measured first in improvement of lamps.

In this connection the development of the tungsten lamp stands out most prominently. This, in high candle-powers, is a serious competitor of the arc lamp both for indoor and outdoor lighting, and has largely superseded the carbon filament lamp, as shown by the following table taken from a recently published article giving the relative number of lamps sold.

Type.	1907 Per cent.	1908 Per cent.	1909 Per cent.	1910 Per cent.	1911 Per cent.	1912 Per cent.
Carbon	93.27	84.12	68.98	63.08	52.90	25.47
Gem	5.88	8.58	15.07	14.88	19.00	33.59
Tantalum	0.75	1.78	2.12	3.57	2.74	1.00
Tungsten	0.10	5.52	13.83	18.47	25.30	39.94
Total	100.00	100.00	100.00	100.00	99.94	100.00

It is extremely probable that more recent figures will show that the tungsten lamp, aided by greatly reduced price, its high efficiency and the fact that electric companies are beginning to make free renewals of tungsten lamps as they did of the carbon filament, is destined to make the carbon filament lamp a vanishing quantity. In this connection it is interesting to note that the United States government has issued an order thru the office of the supervising architect of the Treasury Department that carbon and metallized carbon-filament lamps are not to be used in any of the government buildings, and any such lamps in use at the time of the receipt of the order must be removed and 25-watt tungsten lamps substituted.

There has been marked improvement in the life of some of the higher wattage 100-volt types and in compensator and train lighting lamps. In the 60, 100 and 150-watt, 100-volt lamps improvements in life have taken place similar to those

made last year in the cases of the 250, 400 and 500-watt lamps. This improvement in quality is on the order of 50 per cent. in life and has made possible substantial improvements in efficiency. The use of chemicals—the so-called "vacuum getter," in the bulbs of these lamps for reducing the blackening of globes has largely brought about these improvements. At present the commercial efficiencies of these types are around 1.17 w.p.c. while the higher wattage types are put out at about 1 w. p. c.

¶ MERCURY *vapor lamp and the tungsten have been combined, producing a white light very suitable for street lighting.*

Improvements in the tungsten wire-drawing process have made it possible to manufacture wire of almost exactly the desired size and so render it possible for manufacturers to make lamps of so nearly the desired voltage and efficiency that the function of photometry in the lamp factory is now principally to guard against errors in manufacture. This improvement has been adopted by most of the manufacturers in this country for all lamps intended for series burning service and has been productive of greatly improved results in all cases.

A 10-watt, 100 to 130-volt lamp and a 5-watt, 50 to 60-volt lamp have been developed. These are important additions to the line of sign lamps in that they furnish a low wattage lamp that does not require the operation of more than two lamps in series upon 100 or 200-volt circuits.

A new filament consisting of an alloy of tungsten has also been brought out. It is claimed that this not only possesses the strength and efficiency of drawn tungsten, but that it will withstand crystallization for a longer period.

Possibly the most startling development in the tungsten lamp is the announcement of one giving an efficiency of 0.5 watt per candle. A specially shaped tungsten filament is used in a bulb containing an inert gas, as nitrogen, at a pressure of about one atmosphere. The types to be developed first are adapted to high current consumption, say 6 amperes and over.

A tungsten lamp has recently been brought out which gives a color very closely resembling that of daylight. The energy consumption of this lamp is about 1.4 watts per candle, and it has a candle-power of from 70 to 75.

The open and enclosed series and multiple arc lamps are fast disappearing, their places being taken by the magnetite and the flame arc lamps. There seems to be during the past year, as far as arc lamps are concerned, a strong tendency towards the use of larger units and the cutting down of the intrinsic brilliancy of the arc even at a sacrifice of efficiency.

The flame arc lamp is of special value in lighting large areas, and is particularly adapted to smoky and dusty places, such as foundries, blacksmith shops, and railroad train sheds. In fact one of the largest railroads in the country spent months in trying out various systems of lighting for the train shed of one of their large stations, and, after experimenting with various systems of lighting finally decided to use the flame arc lamp exclusively, adopting it also for the yard.

This lamp has been improved so that the fumes thrown off by the arc condensed and so are prevented from forming a deposit on the globe and from escaping into the air. The lamp is also economical as far as maintenance is concerned, as one set of carbons will burn from 100 to 120 hours without attention.

A rather novel device is an arrangement for converting any enclosed arc lamp, alternating or direct current, series or multiple, and regardless of voltage, into a flame arc lamp.

¶ IMPROVEMENTS *in wire drawing have made possible the making of lamps of almost any desired voltage or efficiency.*

One of the more recent developments of the mercury vapor lamp is a combination with the tungsten, an apparent white light being thereby produced. The unit is very compact and is furnished with a novel starting device. The consumption of this lamp is claimed to be 0.73 watt per mean hemispherical candle-power. Another recent form of mercury vapor lamp is one with a specially designed quartz tube and designed particularly for street lighting. This lamp is started by means of a heated spiral which vaporizes a small portion of the mercury; this is automatically cut out of circuit when the lamp is in operation, and renders tipping unnecessary. The lamp is recommended for the varying voltages met with on traction circuits and is said to consume about 0.4 watt per candle.

The value of the ultra-violet rays of the quartz tube mercury vapor lamp is becoming recognized. The lamp is now used for sterilizing and the destruction of bacteria. This effect, however, decreases in time, due partly to the formation of an obscuring deposit.

A large number of new types of gas lighting units have made their appearance in both hemispheres. Some of them have been designed with a view to more universal adaptability, such as a burner with a curved bunsen which may be turned either up or down and is therefore, applicable to either upright or inverted burners; some with a view to ease

of maintenance, such as one in which the main feature is the possibility of lifting from the fixture, without the use of pliers; and some with a view to increased efficiency, such as one in which the mixture of gas and air issue at high velocity, resulting in an efficiency claimed to be double that of the standard type; also another lamp with an upright bunsen and an inverted mantle. Low-pressure high-efficiency lamps, particularly for out-door use and giving 1,500 candle-power and with an efficiency of nearly 40 candles per foot have been introduced abroad, but have not yet appeared in this country.

¶ A GAS *mantle has been produced capable of giving* 180 *to* 225 *candle-power. This high-power single mantle allows greater range of globe design.*

What is probably the most important development in gas lighting during the past year is the introduction of a high-power single-mantle inverted lamp filling a place between the old small unit and the multiple mantle lamp. The lamp gives from 180 to 225 mean spherical candles according to the gas used and the pressnre, and thus occupies a space hitherto unfilled. A valuable feature of this lamp is the fact that, because of the single mantle the light is concentrated and reflectors and glassware may be designed with much greater precision than with the multiple mantle lamp.

Hitherto one of the difficulties in connection with the use of high-pressure lamps was the heat developed which limited the kinds of glassware available and also necessitated a globe of very great size. In a modification of one of the high-pressure inverted lamps now in wide use, particularly in England, a small silica cup about 5 inches high, and therefore but little larger than the mantle itself, has been substituted for the globe hitherto used. This cup totally excludes the secondary air supply, all air for combustion being admitted as primary air. The lamp, moreover, is greatly reduced in size and the reflector is omitted. It is claimed that after allowing for the obsorption of light by the silica cup a 10 per cent. increase in efficiency is obtained. These cups are made for lamps of from 60 to 1,500 candle-power. They are very durable and will not break if the mantle gives way and the flame strikes them.

A new high-pressure lamp has also been developed in the United States, designed particularly for street lighting, and working under a pressure of 55 inches of water or 2 pounds per square inch. These lamps are at present made in two sizes—500 and 1,100 candle-power respectively and have an efficiency of over 50 candles per foot of gas per hour. The mantles are of artificial silk and have a life of over 400 hours with practically no depreciation in candle-power.

Automatic gas ignition is having a steady growth. Pilot lights are increasing in number, while the jump-spark and filament igniters are gradually coming into use. Distance control by means of electrically operated gas cocks and also pneumatic control in connection with pilot and jump-spark ignition are being extensively employed, particularly in the past year. It should be noted here that pilot lights have been improved by adopting the bunsen principle and by better protection, so that the danger of extinction is greatly redneed. Self-kindling mantles are also receiving attention, and one improvement recently made in this type of mantle was to mix ammonium chloride with rhodium chloride.

The use of acetylene is increasing for isolated buildings and for distribution from a central plant in very small towns. A large number of burners are available to suit varying needs, but as yet no incandescent burner has been devised for use with acetylene that is thoroughly satisfactory.

¶ A NEW *gas arc developed, for which* 1,200 *candle-power is claimed.*

Air gas systems and systems employing kerosene under pressure for use in connection with incandescent mantles are making considerable progress in the rural districts and other places not reached by city gas and electric plants. The former system, however, has had a setback in the increased price of gasoline and the difficulty in obtaining the high grade necessary. A new modification of the latter system consists of a gas arc lamp connected with the fuel tank by a fine flexible bronze tube. Laboratory tests showing 1,220 candle-power are claimed for this lamp.

The question of street lighting is attracting extraordinary attention. People are no longer satisfied with just enough light to see to move around safely, but are coming to a realizing sense of the advertising and artistic values of ample light. White Ways are almost as common as towns themselves, and where the cities do not seem inclined to install them, the merchants put them in by private subscription. The open arc lamp is a back number, and in many cases the enclosed arc, once so universal, is giving place to magnetite or flaming arcs, or to clusters of tungsten lamps on ornamental poles. The old, severely plain iron or wooden pole is rapidly giving way to the artistic post, and there is a strong tend-

ency to recognize the artistic as well as the utilitarian.

While much publicity is being secured to ornamental lighting, the majority of the business, however, has been connected with the ordinary street lighting, which is, in the electric field, practically working in the direction of the use of the luminous arc lamp, and the tungsten filament incandescent lamp. The increased standard of general street lighting has been largely accelerated by the reduced cost of light, and while it has taken on no distinctively new form, the standard of lumination intensity (not necessarily size of units) has been raised very considerably.

¶ RECENT TESTS *show that twenty-five out of twenty-nine persons favored metallic-filament lamps because of less eye-strain than with arcs.*

An interesting test was made in Switzerland to find the relative advantages of arc and metallic-filament incandescent electric lamps. Two streets of equal length were lighted with 10-ampere electric lamps and 500-candle incandescent lamps respectively. The choice between the two forms of lighting was left to 29 trolley car motormen. Of these 25 favored the metallic-filament lamp on account of lessened glare and irritation to the eyes. The mercury-vapor lamp has been suggested as a street lighting unit, but thus far its use for this purpose has been hardly more than a suggestion, altho in one city lighted by a municipal electric plant, a group of merchants installed six quartz tube lamps to show by contrast the poor character of the general street lighting.

During a "street show" in one of our large cities, ornamental pillars each carrying three electric light globes were erected. Panels in these columns were made transparent by making them of wire netting and coating them with varnish of various colors, giving the effect, when lighted from the inside, of art glass.

In the ornamental lighting system, it is frequently desirable to turn off the lamps without affecting the rest of the circuit. This is done in at least three towns by various systems of pilot wires and magnet switches centering at the central station or other convenient point. In this connection may be noted a method of controlling from the central station switches on a network by superimposing a ripple on the regular voltage. In another town a switchboard has been placed in the office of the chief of police so that in case of burglary or fire alarm after the regular time of shutting off, the ornamental system of street lighting may be turned on.

An unfortunate dispute has arisen in one of the large cities of England over the relative merits of high pressure gas and flaming arc lamps. Two streets were lighted by the rival illuminants and experts representing each of the industries made illumination measurements and prepared reports. The tests were entirely in favor of the electric lamps, but the fact was brought out that the gas lamps were improperly adjusted and installed, so that no conclusions could be drawn as to the relative merits of the two systems. The whole affair caused much argument and a good deal of acrimonious discussion on the part of the advocates of the two systems.

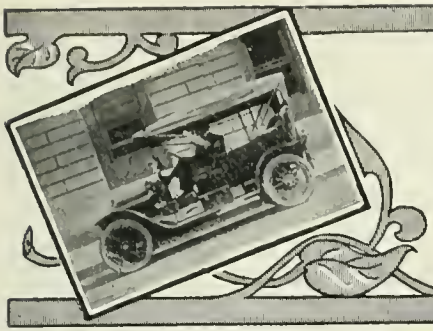
Gas street lighting has made great strides in both England and continental Europe, where high pressure lighting is in great favor. Automatic lighting of gas lamps is also making rapid progress on the other side of the Atlantic, the lamps in a large number of towns being equipped with these appliances. Two systems of automatic lighters are in extensive use, one being operated by a momentary addition to the street main pressure and the other by means of a clock arrangement on each post so that the lamps operate individually and independently. Highly encouraging reports as to the satisfactory and economical working of these systems have been made.

In this country street lighting by gas, while making steady progress, has not experienced the rapid growth that is so marked abroad. Automatic lighting has not as yet obtained a foothold here, and except for two minor installations, there is no high-pressure street lighting. Another difference between European and American practise is that abroad inverted burners are becoming the universal practise, while here, except for a two-mantle 150 candle-power lamp, the inverted burner is not used.

Ornamental street lighting by gas is spreading, a number of prominent installations having been made.

It may be of interest to note that one of our public utility commissions, which had been investigating the street lighting in a large city of the state, recommended that the city employ an illuminating engineer, to be retained permanently if possible, for the purpose of selecting the type of lamps to be used and to fix their location.

Increased interest in street lighting does not seem to be unusual, however, as a recent item in a French technical journal contains the statement that in that country, out of 10,000 villages or communes of more than 1,000 inhabitants, 6,000 are without public lighting.



Automobiles in Municipal Service

Care of Automobile Fire Apparatus

By D. J. McCue, driver of Packard Auto Combination Chemical and Hose Truck, North Bradford, Pa.

A systematic daily routine is necessary in order to properly maintain fire apparatus so that it will operate at its highest efficiency at all times. One of the most important phases of such routine in our station is to first test the motor for compression, ascertaining that it is equal in all cylinders. One weak cylinder will cause a loss of power and often decided missing. Thus when operating upon three cylinders in place of four, the three operating cylinders are dragged own by the one which is inactive. If a fault of this character is not discovered prior to a run serious consequences may develop.

For instance, suppose that upon the last run of the day just before retiring the motor operated correctly. It pulled that last 18 per cent. grade on second gear without a hitch. It came into quarters in apparently perfect working order. The next morning the usual process of cleaning up, polishing brass, inspection of wiring and connections, etc., was made but the driver failed to turn the motor over by hand. He did not test his car for compression inasmuch as it seemed to fire on four cylinders when running idle. The driver then proceeded to clean up. In the course of an hour an alarm was sounded. The alarm called for a run up the hill which had been pulled so successfully the night before. That meant an 18 per cent. grade. The machine left the quarters with its 5-ton load and after some coaxing attained a speed of 30 miles an hour on level streets. Two hundred feet up the grade it became necessary to drop into second speed and with the throttle well open the engine proceeded to drag and drop behind the speed it should maintain on second gear. It then became necessary to use the first or lowest gear and finally the hill was negotiated but not without much worry upon the part of the driver who was in the habit of taking the grade with ease. The apparatus arrived at the fire five to six minutes later than necessary. Everybody, including the firemen, wondered why the powerful and reliable Packard fell down at such a crucial moment. It became necessary to throw two large streams to save what was left, where, under ordinary conditions one 25-gallon chemical tank would have quenched the fire with a comparatively small loss.

Upon arriving at the station a careful inspection developed that on the run the night before the lock nut on the valve push rod had become loose and had worked up four or five-thousandths of an inch, just enough to prevent the exhaust valve from seating properly, thereby causing a loss of compression.

This is but one of the number of things which may happen if the daily routine is not systematically and rigidly carried out.

After receiving the Packard truck now in use in this department we found that it was absolutely essential to develop a routine and to see that this routine was rigidly adhered to in order that the most efficient results could be secured at all times. The result has been that the car has never missed an alarm since April 10, 1911, and it has never taken longer than eight to ten seconds to get the car out of the station.

It has been my experience that a greater amount of attention is necessary when a truck is new than at any other time. This is particularly true of a number of important parts, most particularly the braking system. It is necessary that the brakes be adjusted and that the spring clips be taken up after nearly every run during the first year. It is absolutely essential that a piece of high-powered motor apparatus, which is designed to travel over the streets at excessive speed thru congested districts and in the midst of excited traffic, shall be at all times equipped with the very best of brakes. In order to accomplish this the braking system must be kept in constant adjustment. We find the best method of mak-

ing this adjustment is to jack up the rear axle and rotate each wheel, at the same time noting the resistance of the brakes and adjusting them to operate with as nearly an even pressure on both wheels as is possible to secure.

Of equal importance is the steering apparatus. This should be examined thoroly for any broken bolts, missing nuts or loose connections. On machines which use solid tires, all shocks from rough pavements and roads are transmitted to the steering connections to a much greater degree than where pneumatic tires are used. On machines so equipped it is necessary to maintain frequent and rigid inspections.

Machines which are driven by chains require frequent adjustment in order that the maximum amount of power can at all times be transmitted to the road. This adjustment is made by shortening or lengthening, as necessary, the radius rods on each side of the truck and then being careful to ascertain that the distance between each of the sprocket wheels and the rear axle is the same so that the rear axle will remain square with the frame. If such is not the case both tires and chain will wear unduly.

Such parts as are apt to break frequently should be carried in stock. We always have on hand an extra supply of spark plugs, gaskets, carbureter springs, small magneto parts, etc. Each station should be equipped with the proper tools to work with so that when work is started on a car it can be carried thru expeditiously.

We keep a regular day sheet on the maintenance of our cars. At the end of the month a summary of the day sheets is copied to a monthly record sheet. In this manner daily and monthly costs can be arrived at. The day sheets are headed as follows:

Day of the month.
Number of runs.
Total miles.
Gallons of gasoline.
Gallons of cylinder oil.
Gallons of gear oil.
Gallons of transmission oil.
Graphite grease (pounds).
Tire repairs and replacements (R. F., R. R., L. F., L. R.).
Cost of repairs.
Miscellaneous supplies.

The monthly sheet has the following headings:

Month.
Driver's wages.
Accident repairs.
Routine repairs.
Interest.
Depreciation.
Insurance (liability, property damage, fire and collision).

Daily inspection is not complete until spark plugs have been tested, all wiring connections tightened, batteries tested, radiator and gasoline tank filled, grease cups turned down, tires properly inflated, skid chains in good condition and other minor points attended to, all of which must be in proper condition in order that time shall not be lost when calls come in or on the road.

Maintenance of Motor Driven Fire Apparatus

By O. B. Mercer, Chief of Fire Department, Westville, Conn.

The most important thing in the care of motor fire apparatus, is to keep the engine in perfect running order, and to watch the tires, especially where pneumatic tires are used. The motor should be started at least twice a day, morning and night. If it is a piece of pumping apparatus, the pump should be tried out at regular intervals, providing it has not been in use. After every alarm, or more especially after pumping at a fire, the whole machine should be gone over carefully and all bolts and nuts tightened, spark plugs cleaned and the machine well greased. Test the compression and see if the valves need grinding.

Keep the gasoline and oil tanks full at all times. It is a good plan to prime the engine with gasoline after the regular starting period, as this will enable the engine to start immediately in case of alarm. If the piston rings and valves are tight the engine will start from compression after priming and it will not be necessary to crank the motor.

Oil and grease engine at regular periods. Watch steering knuckles and keep them tight. Keep the wheels of machine well greased, packing front wheels about every three months. In greasing, I find it advisable to use a lighter cup grease in winter than in summer. The grade of grease used in summer generally becomes so hard that it does not work into the bearings in the winter, until they are altogether too hot. Don't try to cut down expenses by buying a cheap cylinder oil. It is better to pay a fair price and get a good oil that will not carbonize rapidly and that will keep motor from over heating.

If the engine is heating look for carbon, see that water is circulating and try compression. If it is not the same on all cylinders, the valves need grinding and should be attended to at once, otherwise the motor will not develop its full power. It is well to try valve push-rods and take up any shake, as this will cause the engine to be noisy and in time lose power.

If the motor back-fires into carbureter the usual fault is too great a quantity of

air and this should be cut down. If the mixture is too rich the engine will probably fire a charge in the muffler, and is also liable to back-fire after switch is turned off. This back firing is not always caused by too rich a mixture, but may be caused by carbon. An overly rich mixture will invariably cause overheating.

There should be two entirely separate ignition systems, one for storage battery and one for magneto, using two sets of spark plugs. This is necessary because one is liable to go wrong and where there are two systems one is always available. The magneto should be wired so that it is not necessary to use the coil, also the magneto should be of a type that will start engine by spinning. Great care should be taken in buying, to see that magneto and battery do not use the same coil. In this case if coil went wrong it would kill both systems. If there is a storage battery on the machine, it should be tested at regular intervals, altho I should prefer to have dry batteries and keep two sets on machine at all times; this may seem expensive but in our case it proved just the opposite, as we were continually having to send storage battery away to be recharged, which leaves the machine with only one ignition system, unless there are two storage batteries, and with dry batteries you can change from one set to the other or get new batteries without a twenty-four hour wait, which is necessary when a storage battery is sent to be recharged. We have had two sets of dry batteries in use over a year and are still using them. In buying, the battery question could be overcome by getting apparatus with a self-starter, which charges its own battery. The same starting rules would apply to self-starter as before stated, inasmuch as a self-starter is just as liable to go wrong as any other part. Every one has his own idea as to which is the best magneto, but we have had perfect results from the Bosch magneto, the motor starting as quickly on the magneto as on battery. Our battery system is the Atwater-Kent from which we have had the best results during the past three years. Extra spark plugs should be kept on hand at all times.

Jack the machine up on swivel jacks when standing idle; it doubles the life of the tires and the swivel allows one to run off without lowering. Jacks need only be used where there are pneumatic tires, and when they are used the machine should be lowered to the floor at least once a day, as the tires are liable to leak and can be tested best in this way.

Demountable tires should be used and a spare tire kept on hand at all times. Keep the tires inflated to the pressure recommended by the manufacturers, as tires that are run soft are liable to cause friction and consequent cracking of the inside of the casing, which will eventually pinch the tube, causing a bad leak.

TEST *of motor driven pumping apparatus. Westville, Conn. During fourteen and a half hours pumping forty gallons of gasoline and seven gallons of oil were used.*

I would recommend the use of a floating strip in tires as this will protect the inner tube for a long period. The life of the tire can be lengthened by having a small vulcanizer on hand and whenever a cut shows on casing, it should be vulcanized at once as this will keep water and sand from getting between rubber casing and fabric, and prevent the fabric from further damage and rotting. This I find is very important.

It is advisable to keep chains on the rear tires at all times. In place of chains some prefer non-skid tires. We have found that chains give us better results and in three years use have not damaged our tires in any way. This might not apply to a car that is running two or three hundred miles every day, but with fire apparatus the runs are generally short and only taken once in awhile. I think chains are safer. Cross bars on

chains will wear out rapidly but can be replaced at a nominal cost and with very little trouble.

Cost of maintenance will vary with price and the amount of running down. In our case we have blown out two shoes and bought five new tubes in three years. Tires are the greatest expense, barring accidents. In 14½ hours of pumping we used about 40 gallons of gasoline and about 7 gallons cylinder oil. The engine was lifting her own water and being forced to limit most of the time.

Since having motor apparatus we have extinguished more fires with chemicals than we ever did with the old system.

The beauty of motor apparatus is that when you have arrived at a fire the driver can become an active fireman. The machine needs no one to watch it, unless it is a pumping engine, and in that case driver acts as engineer. The expense of keeping motor apparatus is very small unless it is in a very busy house. The apparatus costs nothing when not in use.

One of the very important features in buying apparatus is to have it equipped with large enough tires to carry its maximum load. Under-size tires will cause serious trouble in all directions. The larger tires are more expensive, but only in the first buying and will prove cheaper in the end.

The Motor Driven Combination

By A. P. McDavit, Chief of Fire Department, City of Dover, N. J..

We have recently installed a White motor-driven combination chemical and hose wagon. While we have not been operating this piece of apparatus for a sufficient length of time to give detailed figures as to its cost of operation and maintenance as compared with horse-drawn apparatus, we have demonstrated that it is more convenient, economical and speedy as far as fire fighting purposes are concerned.

In most cities using chemical engines or combination chemical and hose wagons, reports state that at least 75 per cent. of the fires are extinguished by chemicals alone. In all probability, the general use of the auto combination will increase this percentage to 85 or 90 per cent. owing to the speed in arriving at the fire consequently the more general use of the chemical tank attached.

The motor-driven combination hose and chemical, in nine cases out of ten, furnished all necessary fire fighting equipment. There is no question in a city of sufficient size and wealth to warrant it, that the maintenance of more wagons with smaller combinations than the triple, is of greatest advantage and will give better service, especially in that most important matter of quick service and speed. If it is a small fire, you have the chemical, and in quantities almost as great as that carried by the chemical alone, and if the water hose is necessary, you would have it in as great quantities as carried by the hose wagon alone.

The motor-driven combination can be used for many different purposes; as an ambulance, it will be the means of saving the lives of those overcome by smoke or gases, or who have been injured in other ways, by affording quick transportation to the hospital; as a fuel wagon, fuel can be furnished the engines more expeditiously, especially when the engines are at some distance from the supply base.

In using horse-drawn apparatus, if a horse falls and breaks a leg, the horse must be shot, but with the automobile repairs are made and the apparatus is as good as ever; and it is my belief that there will be less failures to arrive in response to alarms with the auto apparatus than with the horse-drawn apparatus. There are no horses to feed when the machine is not in use and the expense is practically nothing when not actually in service. Comparing with the horse: The automobile can get to the fire quicker; is more reliable; never tires; only fed when working; less danger of accidents, being under better control of driver than horses; driver to be used as fireman; takes less room; no stable; no attraction or breeding place for flies; less cost of maintenance.

The motor-driven combination hose and chemical is a great success in handling brush and grass fires, getting on the job so much quicker than horse-drawn apparatus that the fire is still of no great extent and so will be handled in much shorter time and the apparatus and men returned to station ready for the next run, the auto apparatus making quick returns as well as quick responses.

Looked at from the economical side, there will be a great saving in space occupied, so that new stations may be much smaller, lots purchased may be much smaller, and the total expense will also be correspondingly reduced. Cost of heating and lighting and water bills will be reduced. There will be a saving of one man as the driver will have no horses to watch and can be used as a fireman in fighting the fire.

We can cover a much larger territory, so, altho we must have enough apparatus and equipment for the very large fires. I think the time will come when more apparatus will be kept as a reserve and possibly a reserve force of men to be called only in time of a very large fire.

Our new combination, which was furnished us by the White Company, Cleveland, Ohio, has 6-cylinder, 60-h.p. engine

with an electric starter and employs the Kanawha air system for chemical pressure. Twelve hundred feet of 2½-inch hose are carried in a steel hose bed which is quickly accessible from the rear running board. The bed occupies the conventional position between the two seats running lengthwise of the truck. The seats, capable of seating eight men, have good cushions. Under the seats are lockers. Portable chemicals are strapped to the running board and the large nozzles for the 2½-inch hose are carried on posts that are built on the rear running board. Hooks, lanterns, axes, etc., are carried along the side of the body, a 50-gallon chemical tank is mounted in the customary place in a recession between the driver's seat and the hose bed, while the chemical hose, 250 feet long, is coiled in a steel basket immediately above the chemical tank. For this class of apparatus, where seconds count in getting under way, the White electrical starting system is particularly valuable. It has the unusual advantages of preventing the motor from stalling at all times and without any attention on the part of the driver. Both the functions of starting and lighting are performed by one mechanism, the motor generator, which is mounted at the forward left side of the engine and driven by silent chain. The entire control is centered in a single knife-blade switch located on the dash. When the driver has closed the switch, the electric system assumes its duties and performs every function without any further attention and without the assistance of any automatic regulating devices. Both the control of the generator capacity and the change of its functions from that of a generator to a motor are accomplished entirely by the design of the unit itself. Closing the switch connects the 9-cell battery and puts the electrical pressure above or below that of the battery. At engine speeds above a certain definite point it is a generator and below that point it becomes a motor, so that should the engine stall in traffic the electric motor will automatically "pick it up" and restart it without any attention on the part of the driver.

Motor Driven Fire Apparatus as an Investment

By J. E. Shrewsbury, Chief Engineer, Fire Department, Long Beach, Cal.

The city of Long Beach has one Robinson Jumbo pumping engine with a rated capacity of 700 gallons per minute. At the acceptance test it drafted from the reservoir and delivered 715 gallons per minute. For the year preceding July 1, 1912, it achieved the following record:

Alarms answered, 34.
Distance traveled, 158 miles.
Pumped at fires, 4 hours, 50 minutes.
Pumped at drills, 1 hour, 30 minutes.

Expenses.

Gasoline, 158 gallons, at 18c....	$ 28.24
Cylinder oil, 15 gallons, at 42c..	6.30
Kerosene, 15 gallons, at 9c.....	1.35
Hard oil, 5 pounds, at 15c.....	.75
Spark plugs, 3 at 50 cents.....	1.50
Repairs on strut rods.....	2.00
Driver's salary, 12 mo., at $95...	1,140.00
Total cost maintaining auto..	$1,180.14

For comparison's sake I submit a conservative statement of the cost of maintaining one-third size steamer for the same period of time:

Engineer's salary, one year....	$1,200.00
Driver's salary, one year.....	1,020.00
Feed for two horses, one year..	360.00
Horseshoeing	48.00
Fuel for heater	324.00
Coal	30.00
Oil	2.00
Total cost maintaining engine.	$2,984.00

In addition to that, there is the cost of maintaining the hose wagon as tabulated below:

Driver's salary, one year	$1,020.00
Feed for one team, one year....	360.00
Horseshoeing	48.00
Total cost maintaining hose wagon	$1,428.00

Thus it is demonstrated that the cost of maintaining a third-size steamer for one year is $2,984.00, and its hose wagon $1,428.00, which makes a total of $4,412.00 for the steamer and wagon for one year, as against $1,180.14 for the auto engine combination complete, which is a saving of $3,231.86 in favor of the auto rig per annum. In other words, the steamer equipment, complete, costs 273 per cent. more per year for maintenance than the auto engine equipment.

Our auto engine has covered all outside territory, making some runs of 3 miles length, and has never given us any trouble. It also answers all second alarms in the business district, while the steamer covers a radius of not over a mile from the central station. The auto engine has made a speed of 35 miles per hour, but we have a limit of 25 miles per hour when answering alarms. The driver has orders to drive slow on rough roads, never driving at a higher rate of speed than will permit him to maintain perfect control of the machine at all times.

When working at fires the engine should be kept at its normal speed when possible, and the pressure regulated by means of the by-pass and relief valve. I

find on long lines, where a good pressure of from 175 to 200 pounds is required, that by running the engine at full speed and opening the by-pass, the engine handles the stream to better advantage than in any other way.

On September 3, Ocean Park, Los Angeles county, experienced a serious conflagration. When they called on Chief Archie J. Eley, of the Los Angeles department for assistance, he immediately ordered that engine number 26, which is also a Robinson "Jumbo" similar to our engine, carrying its own hose, and the auto hose wagon, number 5, be despatched to their assistance. The auto engine covered the 11 miles and had water on the fire in 27 minutes. He also ordered that two steamers be sent at the same time, and they were accordingly loaded on cars and shipped to Ocean Park, 2 hours and 45 minutes elapsing between the time they were despatched and their arrival. It was then found impossible to unload them, as there was no platform available, making it impossible for them to render any assistance and leaving the work of saving the city of Venice and the remainder of Ocean Park to the auto engine and the high pressure water system of Venice. The auto engine ran thru places that it would have been impossible to drive a team of horses, on account of the excessive heat and smoke and the flying sparks, and was moved from plug to plug as the water supply was exhausted in a remarkably short time, practically saving the remainder of the town and possibly the city of Venice. I believe that while this engine was on the ground it accomplished as much good as two steamers would have done, considering the time it took to move and that it was pumping first fresh and then salt water and experienced no trouble about fuel.

The gas engine has proven its worth in automobiles, electric plants, motor boats and holds an exclusive position of usefulness in aviation. Tho hundreds of gas engines are being produced by men who are not familiar with the elementary principles of them, they have demonstrated their worth to the entire satisfaction of all, and I can see no valid reason why they are not as reliable as steam engines, in fact, they are supplanting steam engines in nearly every line of industry, and I believe they have less chance of failure than the steamer with its many ailments, such as explosions, leaks, foaming, poor coal, etc.

A very commendable feature which interests all city officials and especially the chief is the cost of maintaining the department and the apparatus in particular, as this is where the economizing can be first seen. In my opinion I have demonstrated by actual figures that the automobile pumping engine will save its purchase price in three years.

Mayor Crump Now Back on the Job

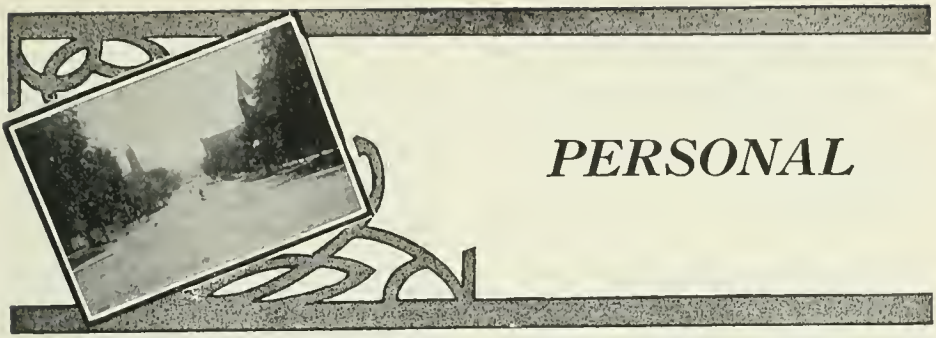
"All a Memphian need do to make him appreciate Memphis is to go away from home and keep his eyes open."

This was Mayor Crump's declaration upon his return to Memphis, after spending a month with his family at Beach Haven, New Jersey.

"When a fellow goes to other cities and sees a lot of dilapidated buildings, poorly kept up streets, garbage and rubbish lying around everywhere, unpainted telephone poles, and a dozen and one other evidences of neglect, it makes him feel right glad he is living in a progressive city like Memphis," said the mayor. "I want to say right now that we do not suffer by comparison with any city in the country."

MAYOR CRUMP, *of Memphis, Tenn., after a successful fishing expedition.*

The accompanying snapshot bears out Mayor Crump's assertion that the fish were biting in New Jersey. The mayor is shown with two of his sons, Edward and Robert, en route home with a morning's catch.



PERSONAL

American Society of Municipal Improvements

The principal features of the Wilmington convention of the American Society of Municipal Improvements, held October 6 to 9, were the consummation of the amalgamation of the Association for Standardizing Paving Specifications with the older organization, the full discussion of specifications and adoption of such as had reached that stage, and the first report of the committee on standard forms for receiving bids and recording costs of municipal improvements.

In accordance with the terms proposed and recommended by committees of the two organizations, membership of cities in the A. S. M. I., with delegate representation at conventions is provided; a past president of the A. S. P. S. becomes chairman of the general committee on standard specifications and George W. Tillson, the consulting engineer of Brooklyn, N. Y., has accepted that appointment; also the members of committees of the one society become members of the corresponding sub-committees of the other, thus increasing the membership in these sub-committees of the A. S. M. I., beyond the three or four heretofore customary. The system of reports of sub-committees on the specifications to the general committee and of discussions of these reports by all interested at open meetings of the general committee and the sub-committees is continued. The discussions of the sewer and brick committee reports at the Wilmington convention demonstrated again their value as a time-saver as well as an outlet for the oratory of those having changes to propose of these preliminary discussions.

The sewer and sewage disposal problems occupied more of the time of the convention and its committee annex than any other subjects, and while the discussion was not completed and the report was not finally adopted, nearly all of the specifications were approved informally and can be used pending the final completion of the consideration.

The discussion on the brick question was nearly all in a special meeting of the committees called in the cabin on the boat during the trip on the bay, and centered about the method of selecting brick for test. The method proposed for the American Society for Testing Materials and described in Professor Edward Orton's paper before the society was not approved by the committee at large, and the selection method now provided for in the adopted specifications was allowed to stand. A committee was appointed to confer with the committee of the Society for Testing Materials, with a view to reaching an agreement upon this point, which is almost the only point of difference between the specifications of methods of testing brick of the two societies.

The election of officers resulted in moving the vice-presidents up one notch, E. H. Christ, of Grand Rapids, Mich., becoming president, and Norman S. Sprague, of Pittsburg, Pa., the last president of the A. S. P. S., being selected to fill the vacant third vice-presidency. A. Prescott Folwell, who has been the very efficient secretary of the association for the past six years, declined re-election and Charles Carroll Brown, 702 Wulsin Bldg., Indianapolis, Ind., was elected to fill his place. W. B. Howe, city engineer, Concord, N. H., is the new treasurer.

The exhibits at the convention were an important feature, which is each year making a better showing. The exhibitors included Charles Warner Co., Wilmington, Del.; Barrett Mfg. Co., Philadelphia, Pa.; Yellow Pine Manufacturers' Association, St. Louis, Mo.; Barber Asphalt Paving Co., Philadelphia, Pa.; Dunn Wire-Cut-Lug Brick Co., Conneaut, O.; Buff & Buff Mfg. Co., New York City; Union Clay Products Co., New Brunswick, N. J.; Good Roads Machinery Co., Kennett Square, Pa.; Robeson Process Co., Pennington, N. J.; Lock Joint Pipe Co., New York City; Warren-Knight Co., Philadelphia, Pa.; Coleman DuPont Road, Inc., Bureau of Inspection, Wilmington, Del.; National Water Main Cleaning Co., New York City;

Bausch & Lomb Optical Co., Rochester, N. Y.; U. S. Asphalt Refining Co., New York City; Addressograph Co., Chicago, Ill.; Electro Bleaching Gas Co., New York City; National Association of Paving Brick Manufacturers, Cleveland, O.; Warren Brothers Company, Boston, Mass.; Lehigh Portland Cement Co., Allentown, Pa.

The next convention will be held in Boston, Mass.

American Road Congress

The third American Road Congress, held in Detroit the week of October 1, registered 3,600, making it the largest meeting of its kind that has been held. The program as outlined in the September number of MUNICIPAL ENGINEERING was followed closely. The exhibit feature was as important as usual. The outside interest in the Wayne county concrete roads was intense largely because of the intention on the part of those interested in materials for making hard roads to make sure that visitors saw all the points favorable and unfavorable to the roads in question. The paving determinator under the conditions existing made very different showing from its former work and demonstrated, if the demonstration was necessary, that the machine and the conditions under which it works must be studied in great detail and thoroly standardized before its indications can be accepted as of any value. A number of new machines for road work were exhibited. The officers of the American Highway Association were re-elected, J. E. Pennybacker, Colorado Bldg., Washington, D. C., secretary.

The resolutions adopted by the congress favor a National Board of Public Works with its head a cabinet officer; state highway commissions and state aid for road construction and maintenance; a national road system with state, county and town laterals and connecting roads to markets; a commission to study and recommend a system of federal aid; official national representation at International Road Congress; investigation by the U. S. Office of Public Roads of applications for patents affecting road and bridge construction; both the Lincoln Highway and the National Old Trails Associations; compulsory use of wide tires and the road drag; use of convicts in road construction and maintenance; long tenure of office of efficient highway officials.

Technical Associations

The New York State Road Builders' Association is an organization three years old which is devoted to the benefit of highway contractors. Connecticut has a similar association. And now the New York organization proposes organizations of the same sort in all states in which highway improvements are under way, with an affiliation of the state organizations with each other for concerted action on matters of common interest. John J. Ryan, 25 N. Pearl St., Albany, N. Y., is secretary of the New York association.

An exhibition of American and foreign city planning will be held in New York City Nov. 24 to Dec. 6, 1913, under the direction of the Heights of Buildings Committee of the Board of Estimate and Apportionment of the city of New York. The exhibit will be arranged under 22 general heads and many sub-heads, including buildings of various classifications, fire protection, markets, legal restrictions, parks, streets, transportation, waste disposal, water supply, taxation, etc. Much of the exhibit will be available for use in other cities after this exhibition has closed and it will probably travel about the country as may be desired. Material for the exhibition may be sent to the American City Bureau, 93 Nassau St., New York.

The United States Good Roads Association will hold a convention and exposition in St. Louis, Mo., Nov. 10 to 15, 1913. J. H. Bankhead, Washington, D. C., U. S. Senator from Alabama, is president, and J. A. Rountree, Birmingham, Ala., is secretary.

A national conference on concrete road building, will be held at the Auditorium Hotel, Chicago, Feb. 12 to 14, 1914, under the auspices of an advisory committee of which Prof. W. F. M. Goss is chairman, and J. P. Beck, 72 W. Adams St., Chicago, Ill., is secretary. It will be held during the annual Chicago cement show. Other organizations which will meet during the progress of the show are the American Concrete Institute, Interstate Cement Tile Manufacturers' Association, National Association of Sand and Gravel Producers, Illinois Lumber and Builders' Supply Dealers' Association and the National Builders' Supply Association.

The tenth convention of the American Road Builders' Association will be held in Philadelphia, Pa., Dec. 9 to 12. There will be about five sessions devoted to papers and discussions, including a popular mass meeting, and an afternoon and an evening will be given to entertainment and an automobile inspection of the city. The usual exhibit of road materials and machinery will be held at the First Regiment Armory, where the sessions of the convention will also be held, and national, state and technical exhibits will be even more complete than at Cincinnati last year. E. L. Powers, secretary, 150 Nassau St., New York City.

Special freight rates on exhibits for the Panama-California Exposition to be held

at San Diego, Cal., during the entire year 1915 have been announced with free return of all but one or two classes.

The American Society of Engineer Draftsmen has become strong enough to begin the publication of a monthly journal, publishing papers delivered before the society, book notes, correspondence and an index of articles on drafting and allied subjects in current publications. Walter M. Smyth, 74 Cortlandt St., New York, is secretary.

The Panama-Pacific Exposition at San Francisco is now in the rush of construction and is up to schedule time which will finish the buildings nine months ahead of the opening time. The committee having the Engineering Congress in charge is now sending information regarding membership and the distribution of the proceedings which promise to be one of the most valuable collections of descriptions of engineering works of all sorts and reports of progress ever made.

The New York Electrical Society, founded in 1881, is now publishing its transactions regularly, six numbers having appeared in the past year. At its meeting held Oct. 23, L. A. Hawkins presented a paper on "The Place of America in Scientific Research Work." Geo. H. Guy, secretary, Engineering Societies Building.

The Merchants' Association of New York has established itself in its new offices in the Woolworth building and is now able to enlarge its valuable work in the advancement of the commercial and civic interests of the city.

The second annual fall meeting of the Vermont Society of Engineers was held in Burlington, Oct. 8. An interesting paper on hydrographic surveying, an inspection trip to dam, concrete arch bridge and hydro-electric plant under construction, the business of the society and a "round table" supper filed the day and evening. Geo. A. Reed, secretary.

At the meeting of the Municipal Engineers of the City of New York on Oct. 22, the work of the department of street cleaning was described by Fred L. Stearns the superintendent of final disposition of the department. On Oct. 17 the society visited the Bethlehem steel plant. Geo. A. Tabor, secretary.

The Indianapolis-Lafayette section of the American Institute of Electrical Engineers heard a paper by Lewis L. Tatum on industrial motor control at its first meeting of the year, held Oct. 10. G. B. Schley, secretary.

The Brooklyn Engineers' Club had a paper by Charles S. Doron at its October meeting on the shore road improvement made by the department of parks of Brooklyn.

The Colorado Association of Members of the American Society of Civil Engineers at its October meeting heard Leonard Lundgren, of the U. S. Forest Service, on the organization and conservation policy of that office, especially as to water and power development.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places as follows:

Nov. 5-6—Aid in Bureau of Standards, Department of Commerce, at $600 to $720 a year.

Nov. 10—For various grades of Electrometallurgist, assistant metallurgist, metallurgical engineer, metallurgist, chief metallurgist at salaries of -1,800 to $4,800 a year; also assistant petroleum chemist at San Francisco or Pittsburg, at $1,800 to $2,160 a year; all in the Bureau of Mines, Department of the Interior.

Personals

Preparatory to the design and construction of a garbage disposal plant at Corpus Christi, Tex., Mayor Miller, Commissioners Uehlinger and Sutherland and City Engineer Stevens during the past month inspected similar plants at Houston and Galveston. This inspection has resulted in the acquisition of much practical information which will prove of value in the design of the Corpus Christi plant, upon which $20,000 will be spent.

Chief Engineer Hendrick, of the Baltimore Sewage Commission, recently reported to the commission that during the month of September over 3,400 men were employed on sewer construction work in that city. He estimates that on this basis over 17,000 people of the city are dependent upon the commission for their daily living. This fact gives some conception of the magnitude of the work Baltimore is now carrying on.

One of the latest developments in connection with the Chicago garbage disposal problem is the recent announcement by a committee composed of Chairman Nance, Col. Henry A. Allen, the city's engineering adviser, and Miss Mary McDowell, that a number of experts from over the country will be called into consultation to relate their experiences and knowledge upon this question. Among those already listed are A. Tuska, of New York, Supt. Osborne, of the Columbus, O., municipal plant, and Langdon Pearse, engineer for the Chicago sanitary district. Dr. J. M. Hirsh has presented a proposition to the commission in which he offers to pay the city ten cents a ton for all garbage delivered to him for reduction in a plant which he claims can be constructed within thirty days. His plan contemplates reduction

by a chemical process which has not yet been made public.

A recent decision by Chairman Compton of the Baltimore Paving Commission is expected to broaden competition on sheet-asphalt paving in that city and to prevent the cost of work of this character from soaring. It has been announced that hereafter bids will be considered from general contractors under the commission's specifications and the work awarded providing the contractor can assure the commission and board of awards that he is in a position to perform the work satisfactorily. Heretofore it has been practically impossible for five or six local contractors engaged in brick and granite block work to bid on asphalt paving. This move will probably place in full operation several asphalt plants which during the past have only been working two or three days in the week.

In a recent address before the Commercial Club of St. Cloud, Minn., Hiram A. Cool, paving expert of Minneapolis and Chicago stated that the maintenance of creosoted wood block pavements in Minneapolis to the extent of 1,920,..10 square yards the original cost of which had been $2,777,534 had for the past 11 years totaled $655.56 which amounts to a repair cost of two-hundredths of one per cent. In 1910 the repair cost on pavements laid two years prior was one-hundredth of one per cent., and in 1911 and 1912 it was six-hundredths of one per cent.

October first Governor McCreary of Kentucky issued a proclamation calling upon the people in every county in the state to work on the roads on two days, October twenty-fourth and fifth beginning at eight o'clock each day and continuing until five in the afternoon. The county judge and engineer in each county were authorized to organize and aid the people in every manner possible and to also select such persons as they needed to assist in the work. In counties not having highway engineers the sheriff was given the same authority and power as in counties having engineers. Governor McCreary appealed to the patriotism of the people of his state to do their utmost to place the dirt, gravel roads and turnpikes in the best possible conditions during the two days of work.

The city of Detroit was recently confronted with the problem of selling $1,000,000 worth of bonds for its educational fund to provide new schools. The rate of interest offered was 4 per cent., and owing to the inactivity of the bond market some trouble was encountered in effecting sales. Henry Ford was approached with a view to selling to him a portion of the issue. In the course of a short interview Ford announced that he would take the entire issue at par. Inasmuch as the city had anticipated that it would be necessary to place the bonds on the market on a $4\frac{1}{2}$ per cent. basis, the sale as finally consumated will mean a saving of $150,000 over a period of 30 years. In another light this may be considered as a donation to the city.

Technical Schools

Dr. Earle B. Phelps, of the biological department of the Massachusetts Institute of Technology has resigned to enter the U. S. Public Health Service in his specialty of chemical biology. Robert Spurr Weston has been appointed assistant professor of public health engineering and while not assuming the same work will fill the vacancy in the faculty. Mr. Weston graduated from the Institute 20 years ago and has been a successful consulting sanitary engineer for about 15 years, after large opportunities in study at home and abroad and experience in engineering construction.

Harvard University and the Massachusetts Institute of Technology begin this fall in co-operation a school for public health officers, which will have access to the facilities of both institutions and give a certificate of public health (C. P. H.) signed by presidents of both. It is a post-graduate course for college students, a medical degree not being necessary, tho desirable, for admission. Prof. M. J. Rosenan, of Harvard, is the director of the school.

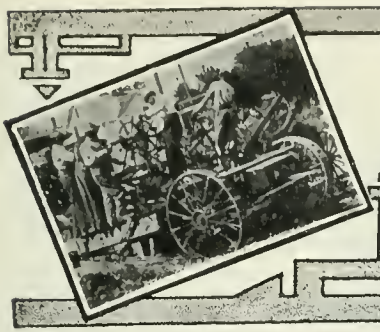
New Publications

A new magazine is entitled *The Efficient Citizen* seems to be devoted to the work of the business booster, the city development promoter, the commercial organizations which can do so much for the uplift and advancement of their communities. It is published in New York and is a monthly.

Concrete Roads and Pavements. By E. S. Hanson, affiliate member of Western Society of Engineers, Editor *The Cement Era*. Chicago, Ill. Cloth, 227 pp.

Annual report of the Department of Public Works of Cincinnati, O. Paper, 118 pp. Victor T. Price, director of public service; Henry M. Waite, city engineer.

Wright on Quantities, a plea for a better system of estimating cost of buildings in the United States. 16 pp., 50 cents; Wright on Building Arbitrations; a manual for architects, students, contractors and construction engineers, 46 pp., $1. By G. Alexander Wright, M. San Francisco Chapter A. I. A., M. Tech. Soc. of Pac. Coast. 571 California street, San Francisco, Cal.



MACHINERY AND SUPPLIES

Pavement Doubly Reinforced

Both top and bottom of the concrete pavement laid in Parkview avenue, Detroit, Mich., in October, 1912, were reinforced with a mat of round bars fabricated on a wooden frame having the exact slopes of the finished street. Stools made of 3/16 by 1 by 1-inch angles support the rods exactly in place and tie the top and bottom bars together. While this street is in a residential district it leads from Jefferson avenue to the water and sewage pumping stations, to which there is more or less heavy teaming. Formerly this 28-foot street was paved with cedar blocks, of which very little remained. The concrete pavement is 6½ inches thick, laid on what was left of the old macadam base. There is a 4-inch bottom course of 1:1½:2 mixture, over which there was laid 2½ inches of finish composed of 1 part cement to 2 parts crushed granite chips.

Both ways the ¼-inch bars on top are spaced on 2-foot centers, while the ⅜-inch bars on the bottom are 4 feet apart. The bars are threaded thru the punched openings in the stool, which raise the lower bars 1¼ inches from the base and space the top bars 1¾ inches from the top of the pavement. Rigidity of the mat is secured by closing onto the bars the punched metal strip below the hole for the bars with a special tool.

Every 30 feet there are expansion joints consisting of 3/16 by 3-inch steel strips secured to the concrete by S-shaped bars, one end of which is hooked over a reinforcing bar and the other inserted in a loop punched from the steel strip. A space of ½-inch between adjacent slabs is filled with asphalt.

Several miles of concrete pavement in and near Detroit have been reinforced by this method, which is controlled by the Thomas Steel Reinforcement Company, of Detroit, Mich. It is the claim of the company that the bottom reinforcement, which is less than that on top, will care for all cracks that might be caused by the irregular motion of the mass of concrete due to the friction between the uneven surface of the sub-grade and the slabs, especially under the influences of arch action or the entrance of water under the pavement which, in freezing, would produce an upward pressure at the sides causing cracks near the slab center. The top bars are placed to care for shrinkage and temperature stresses as well as cantilever stresses induced when heavy loads pass over the soft spot in the subgrade near the edges of the slabs.

Creosoted Wood Block Pavement in Duluth

By John Wilson, City Engineer, Duluth, Minn.

Our system requires the city to pay about 10 per cent. more for paving an avenue than it does for paving a street: and it pays a larger per centage for paving a narrow street in the residence district than it does for a wider street in the central portion of the city, where the public benefit is greater. The proportion of cost borne by the property and by the city should be determined along scientific lines, and not by an arbitrary rule, which is an outgrowth of arbitrary methods sometimes used in making assessments. A pavement that is laid for public benefit should not be paid for simply because one happens to live in a vicinity; nor should the city pay for a pavement that is being laid solely for the benefit of adjoining property. Then, too, some consideration should be given to the question of use, life, repairs, maintenance, etc. At present the economic interests of the abutting property owners and that of the city are not the same, in fact they are actually antagonistic. The less the first cost the better for the property, the less the cost of repairs the better for the city; and as a rule pavements of low first cost are not cheaply repaired or maintained.

We have had no up-keep or maintenance cost on the 15,940 square yards of long leaf yellow pine wood block paving laid on First street in 1905. In 1912, 9,568 square yards of the same pavement

were laid on Central avenue, and there is every reason to believe that the first cost of this pavement will also be the only cost. While our experience with creosoted wood block paving has been limited, it has nevertheless been sufficient to cause serious thought. The people's money should be expended for laying more pavement, not for relaying old pavements. Any sheet surface construction of pavement is a constant drain on the city after it has been laid a very few years, and the repairs are very expensive. If the creosoted wood block pavement was as well exploited and as powerfully promoted thruout the United States as are many inferior forms of pavements which disgrace many of our city streets, there would be little else but wood block paving laid in the United States.

The first creosoted wood block pavement in Duluth was laid in 1905. The form of construction was rather unfortunate, and has given rise to considerable unjust criticism of the pavement. The curb on one side of the street is much lower than that on the other, which, together with rather an excessive crown, gives the pavement an exceedingly steep cross grade, which results in quite a slippery pavement. The pavement was also laid with a 2-inch sand cushion beneath the wood block; and this sand has shifted badly, leaving the surface uneven. The repairs on this pavement have been practically nothing, and aside from the objection above mentioned it is still in good condition. We have not been troubled with either bulging or bleeding. Any other pavement subjected to such treatment would be in a sorry state today.

Last year our creosoted block pavements consisted of a 3½-inch block laid on a 1-inch sand cushion and a 5-inch concrete base. Bids were received on both oils, according to the New Orleans specifications, 16-pound treatment. The bids for the heavier oil being about 10 per cent. less than that for the lighter, the contract was let for the heavier, as we did not believe our present knowledge of the comparative values of the two oils would justify the difference in cost. An asphaltic filler was used instead of pitch and no complaints of any kind can be made because of bleeding.

Between the street car tracks we used a 4-inch block. The rails are 7-inch T-rails, and a flange way was provided by cutting the block on a bevel of 1½ inches deep and 6 inches long. The outside block was cut with a square notch so that the ends of the blocks fit up to the web of the rail and the top was ¼ inch below the top of the rail. Along the tracks we used a ½-inch mortar cushion, 1 part cement and 4 parts sand, instead of the 1-inch sand cushion. So far this form of construction has proved very satisfactory. The pavement is almost noiseless, easily cleaned and very easily repaired.

Some four or five years ago the United States government laid as an experiment, on a street in Minneapolis, a wood pavement made up of a great many different kinds of wood, all treated with 1.09 creosote oil, the idea being to ascertain the relative merits of these different kinds so that a selection of material could be made according to the traffic on any particular street or the availability of any material. The kinds of wood used were long leaf pine, Norway pine, tamarack, Douglas fir, western larch, white birch

CREOSOTED YELLOW *pine street, Duluth, Minn. On 15,940 square yards laid in 1904 to date there has been no up-keep or maintenance attached to this kind of pavement.*

and hemlock. The long leaf pine was used to serve as a standard of comparison. The conclusion was reached after the examination of the pavement, four years after it was laid, was that the species used will be tentatively grouped in accordance with the result of this inspection in order of their value for creosote oil paving materials as follows: (1) Long leaf pine; (2) Norway pine, white birch, tamarack, Eastern hemlock; (3) Western larch; (4) Douglas fir.

In the East, as a matter of fact, the long leaf yellow pine block has been used almost entirely up to the present time, the principal exception being black gum. This, however, has not given entirely satisfactory results. Yellow pine stands up exceedingly well under end compression.

MIXING *and depositing Westrumite pavement with Chicago concrete mixer.*

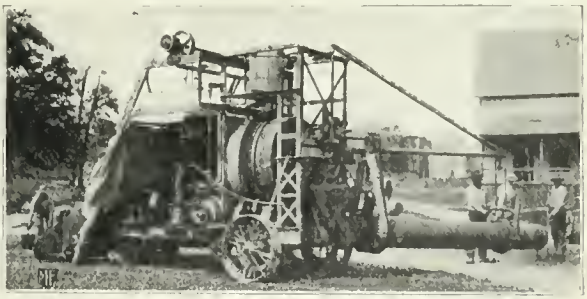
Laying Westrumite Pavements with a Chicago Concrete Mixer

The following article gives a description of the cold method construction of asphaltic pavements in use in many cities. The asphaltic cement is known as Westrumite, and is manufactured by The Westrumite Company at Whiting, Indiana, and by other companies at Washington, D. C.; Portland, Oregon; Brantford, Ontario; Antwerp, Belgium, and Vienna. Austria.

The photographs illustrate the use of the Chicago concrete mixer made by the Chicago Concrete Machinery Company, Milwaukee, Wisconsin, in the construction of Westrumite pavements by Nejdl & Greenwald, contractors, at Whiting, Indiana. The mixer is used both in laying a concrete base and the 2-inch Westrumite wearing surface. The efficient charging device and the revolving tube spout with which it is equipped greatly facilitate the handling and spreading of the material, and reduce the labor cost to a minimum.

Westrumite is a highly efficient asphaltic cement manufactured at present from Trinidad Lake asphalt blended with a special California asphalt, and placed in a temporarily liquid condition by emulsification under the supervision of expert chemists at the factory. It is shipped to the job in barrels, and without any heating or further preparation is mixed cold with the required mineral matter in any concrete mixer. It is then spread on the foundation and after a certain amount of setting, is compressed into a very durable and pleasing surface.

The peculiarity of construction involved, being a combination of the mixing and penetration processes, is adaptable only to a liquified asphaltic cement. The body of the pavement is a coarse hard stone all of which passes the 2-inch ring and is retained on the 1½-inch ring, the use of which gives greater durability and better wearing qualities. This stone is coated in the mixer with a sufficient amount of Westrumite to thoroly cover all the surfaces, and is then spread on the foundation as shown in the first photo. Very little raking is required with the use of a Chicago mixer since the tube spout deposits the material from one side of the street to the other, wherever required. After spreading this coated stone for a distance of about 20 feet, the mixer is run back and spreads the mortar coat over the coarse stone which has not been compacted—merely raked level. This mortar is a mixture of stone screenings, the grading of which is similar to the grading of the stone as required in the Topeka specifications for asphaltic con-



MIXING *and placing mortar coat as wearing surface of Westrumite pavement. Chicago mixer in foreground.*

crete, and sufficient Westrumite to give the proper amount of bitumen. The consistency of this mortar as it is spread on the coarse stone is just at the point of saturation. This very fluid condition causes it to penetrate into every void between the coarse stone. With the evaporation of the vehicle, the asphaltic cement solidifies, and after a thoro rolling during the process of setting, the result is a 2-inch wearing surface which is a dense, compact mixture of hard stone and the very best asphaltic cement. A flushing coat put on by hand with street brooms puts a finishing touch to this unique, yet satisfactory method of construction of asphaltic pavements.

The fact that Westrumite is liquified by emulsification and not by heat allows it to be mixed cold and eliminates the necessity of heating the stone and having it perfectly dry. The asphaltic cement which must be heated to make it liquid, will congeal when it comes in contact with moisture, and would not remain sufficiently liquid to penetrate into the voids of the coarse stone used in this construction. Neither would it penetrate a film of dust that may be coating the stone. The liquified asphaltic cement will, and adheres to the stone, not to the film of dust. Furthermore, the evaporation of the vehicle allows sufficient time to thoroly roll and compact Westrumite asphaltic pavements before solidification.

The elimination of expensive heating machinery and dangers of overheating asphalt; the lowering of labor cost; and the comparative ease of handling and making repairs are features which are making this material more popular every year, and causing this pavement to be adopted all over the country.

With the use of the Chicago concrete mixer in the construction of Westrumite pavements, working steadily thru a ten-hour day, about 1,000 square yards of the 2-inch wearing surface are completed. The same number of men are required to man the mixer for the Westrumite top as for the concrete base. The labor cost is much lower than for any other type of asphaltic pavements. The cost of the pavement complete on a 6-inch concrete base has ranged from $1.80 to $1.90 per square yard in several cities of Lake county, Indiana. Where a broken-stone foundation has been required by cities, the cost of the pavement complete has been about an average of $1.65 per square yard.

Pavement of Buena Vista Avenue, Highland Park, Mich.

By Carl T. Jerome, C. E.

Since it is known that pavements will increase and decrease in length under average conditions, it is advisable to make use of expansion joints across the pavement at certain definite intervals, and these joints should be of sufficient width to allow for the maximum expansion. Since concrete during the time of setting will contract an amount equal to that due to the change in temperature of approximately 100 degrees, it has been argued by some engineers that contraction joints are of more importance than expansion joints. By contraction joints is meant a cutting thru of the entire pavement, or in other words, simply a line of separation of adjacent sections. This may be produced by either using a very thin sheet of steel or by the construction of alternate sections of the pavement. It is, however, in our opinion, unnecessary and in fact, not advisable to make use of contraction joints, for the reason that, assuming that the pavement is constructed during the warmer portions of the year and that the contraction cracks will open up due to the settling of the concrete or to a decrease in temperature or both, these cracks under traffic will become filled with dust and grit to such an extent as to prevent the pavement from expanding when the temperature again rises. We believe, therefore, that expansion joints properly filled with an elastic material should be used to the exclusion of contraction joints, altho it may be safely stated that an expansion joint is also a contraction joint when properly filled and protected at the edges.

A most successful example of concrete pavement with expansion joints properly protected with Trus-Con armor plates is on Buena Vista avenue, Highland Park, Mich. On this job two plates were clamped together with a board of desired thickness between, cutting the entire depth of the pavement. After concrete is poured this board is removed and the space filled with plastic asphaltum. If preferred, a layer of asphaltum felt of desired thickness can be used between the two plates. Either process is satisfactory, will allow the expansion and prevent joint filling with grit; altho the felt method is somewhat cheaper. The assembled plates are held in place at exact grade line by pins driven into subgrade, which are withdrawn after concrete has set.

This pavement was also reinforced with rib-metal, a bar reinforcement, consisting of a series of nine straight bars, or ribs, rigidly connected by cross-ties formed from the same section of steel. The cross-ties accurately space and thoroly anchor the main bar in the concrete, providing a perfect cross-reinforcement against temperature and shrinkage strains. Rib-metal is shipped in flat sheets and there is no unrolling of coils,

Monitor Avenue, Ben Avon, Pa. Constructed with "Tarvia X."

Tarvia in Ben Avon

A FEW years ago Ben Avon, Pa., was still building old-fashioned water-bound macadam roads.

Then the automobiles came and so did the dust.

Something had to be done to prevent disintegration of the road surfaces. The local authorities began experimenting with "Tarvia A" and obtained excellent results.

In 1909 Watt Avenue was constructed with "Tarvia X" and is to-day in perfect condition. The Borough now paves all of its new streets with "Tarvia X" and uses "Tarvia A" for the maintenance of its old macadam surfaces.

A steady policy has been pursued of using "Tarvia A" as fast as possible on the old water-bound surfaces with a result that a large part of the road area in Ben Avon is now in excellent shape.

Mr. C. D. Dyer, President of the Borough Council, states:

> "I cannot express too strongly my recommendation of Barrett products for finishing streets for the use to which they are devoted in a Borough like Ben Avon."

Tarvia is a special coal tar compound which is used as a binder to form a tough, plastic, waterproof matrix around the stone in a macadam road, preventing attrition by automobile traffic and erosion by water.

There are three grades of Tarvia:—"Tarvia X" for road and pavement construction and resurfacing; "Tarvia A" for road maintenance; and "Tarvia B" for dust suppression and road preservation.

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TRADE B MARK

BUENA VISTA AVE., *Highland Park, Mich. Construction of concrete pavement, showing pavement reinforcement being placed, and expansion joint which extends entire depth of pavement.*

cutting to lengths or special labor to hold the steel in place.

Both the armor plate and reinforcing metal as used on this piece of construction were furnished by the Trussed Concrete Steel Company, of Detroit, Mich.

Marble Rock, Iowa, Park Bridge

By Miller Hey Construction Company, Waterloo, Iowa.

The Park Bridge, Marble Rock, Iowa, was designed and constructed by us in 1912 in order to facilitate travel over a ravine between the town of Marble Rock and its city park. The length of the bridge is 97 feet, 4 inches, clear roadway 20 feet, with a 5-foot sidewalk on one side, and the grade line is about 20 feet above the creek bed. Ordinary reinforced deck-girder construction was used; and in order to make a more artistic appearance, curtain walls, 8 inches thick, elliptical in shape, were attached to and concreted with the outside girders. The contract price of this bridge was $3,350.00, and it was completed in fifty days.

The concrete was made from a high grade portland cement and a very good grade of bank gravel, in the proportion of 1:4½ for the girders, floor, coping, columns, and curtains; and 1:6 mixture for the abutments. Screened sand of 1:2½ mixture was used for the hand railing.

For the reinforcing, square twisted bars were used, having an elastic limit of 40,000 pounds per square inch. The concrete was mixed in the above proportions with a Standard low charging mixer as furnished us by the Standard Scale & Supply Company, of Chicago.

The foundations for this work were carried to rock, which was only a few feet below the surface of the ground at the site.

Considerable misapprehension exists as to the strength of gravel concrete in such structures. To secure the necessary strength in gravel concrete, the cement is proportioned in accordance with the amount of sand contained in the gravel; sand being defined as that part of the gravel which will pass thru a ½-inch screen. The only requirement as to relative proportions of sand and stone in the gravel is that the volume of sand must not fall below 0.6 of the volume of stone. Any gravel, therefore, having a sand to stone ratio greater than 0.6 may be used without modification, but for gravel so used the cement ratio must be constant for a given class of concrete. It is necessary, however, to watch the grading of the sand content of the gravel to see that there is a sufficient proportion of the finer particles, that is, those below 1/16 inch. Tho usually gravel sand contains an excess of finer particles, there has been encountered occasionally a gravel that lacked a sufficient amount of the smaller grains to make a good mortar.

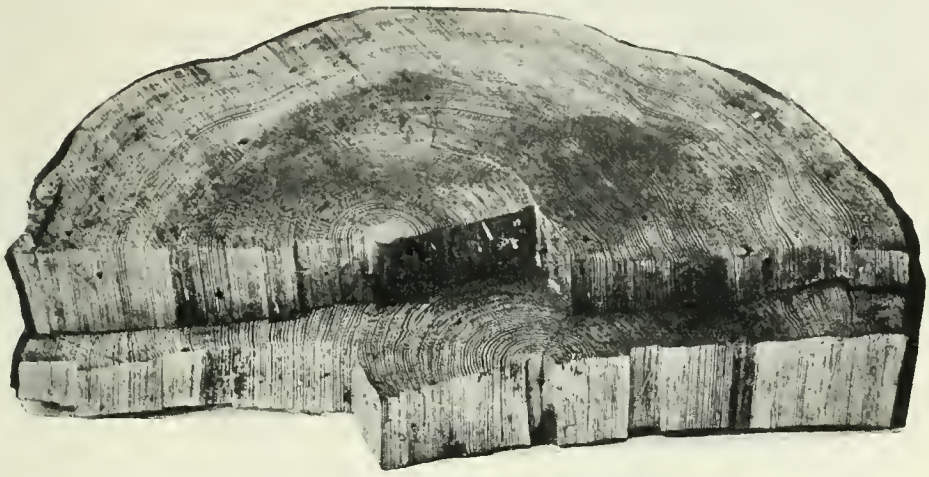
The use of practically all gravels composed of satisfactory material is usually possible under the above provisions. The resulting proportions stated in the usual form may vary for a certain class of concrete, from 1 part cement to 2½ parts sand and 4 parts stone to a mortar mixture of 1 part cement to 2½ parts sand.

This method of proportioning is based on the assumption that if the sand and stone are of satisfactory quality, and the ratio of sand to stone is equal to, or great-

SOUTHERN YELLOW PINE

THE BEST WOOD FOR CREOSOTED PAVING BLOCKS

OWING TO ITS EXTRAORDINARY PHYSICAL CHARACTERISTICS.



Close Annular Rings, Dense, Hard, Strong and Durable.

Mr. H. W. Durham, Chief Engineer in Charge of Highways, Borough of Manhattan, City of New York, states:

> "Our specifications provide that the wood to be used shall be ***Southern Long Leaf Yellow Pine.*** * * * That the popularity of 'Creosoted Wood Blocks' as a paving material is illustrated by its present use—320,000 square yards having been awarded in the City of New York during 1912. * * * Very little trouble and few repairs has resulted when the material has been ***Yellow Pine,*** and the absorption test has been maintained."

The facts are, *Southern Yellow Pine* has made "Creosoted Blocks" a popular paving material, owing to its *great strength under end compression, dense, hard texture, and uniform straight grain.* The resin this wood contains is a preservation in itself, so that Yellow Pine blocks, when properly creosoted, will insure absolute paving satisfaction for *years* in the most trying, congested traffic districts of our largest cities, namely, New York, Boston, Chicago, St. Louis, Atlanta, Cincinnati, Detroit, Louisville, Memphis, etc.

Mr. ENGINEER: Hereafter be explicit. ***Specify*** "Southern Yellow Pine" for your next creosoted paving block contract. It makes an ***economical*** and ***desirable street pavement from every standpoint*** and gives ***longer*** and ***more efficient service*** for the money expended than any other pavement known to engineers.

No royalties paid for its use, and no large repair appropriations necessary.

WRITE FOR LITERATURE AND INFORMATION.

Yellow Pine Manufacturers' Association, 711 Wright Building ST. LOUIS, MO.

PARK BRIDGE, *Marble Park, Iowa, built by Miller Hey Construction Co., Waterloo, Ia., in 1912.*

er than 0.6, the strength of the concrete will be satisfactory, providing the ratio of cement to sand, or in other words the mortar, is always maintained constant for a given class of concrete.

Reinforced Concrete Pavements in St. Johns, Michigan

By E. G. Hulse, City Engineer.

In 1910, we laid our first concrete pavement of about 1,200 square yards, which was placed on just one city block on Spring street. This pavement was 36 feet in width and was laid with joints every 25 feet filled with paving pitch. Longitudinal joints are placed along each curb and are also filled with pitch. The pavement is 7 inches thick in two courses. The bottom 5-inch course is of 1 part cement to 6 parts of pit-run gravel, screening out stones larger than 2½ inches. The top course is 2 inches thick, 1 part cement, 2 parts sand and 3 parts crushed cobbles passing thru a ¾-inch mesh. The pavement surface was covered with tarvia. The cost of laying this pavement was $1.333 per yard. This includes the following items: Excavation, $100; tarvia cost $60.65; curb, $181.47; expansion joints, $20.52; catch basins, $75.00.

Our specifications provide for the use of Baker armor plate for expansion joint and mesh reinforcement. These expansion joints are placed at intervals of 20 to 30 feet extending from curb to curb. Wherever the pavement comes in contact with street car or other tracks, expansion joints are made at the end of the ties in order to provide for vibration caused by the jar of passing cars. These expansion joints are armored and their edges are protected against abrasion by means of 3/16-inch soft steel plates 2½ inches wide which are provided with shear members. These shear members tie the plates securely to the concrete base and wearing surface.

In the year of 1912, we laid approximately 15,000 square yards of reinforced concrete pavement consisting of a base 5 inches thick mixed to the proportion of 1 part of portland cement to 7 parts of gravel including sand. The top wearing surface is 2 inches thick, mixed in the proportion of 1 part portland cement to 3 parts of clean sharp sand. Triangle mesh reinforcement style No. 29 was used as a reinforcement, the same being placed between the base and the wearing courses. Expansion joints were so constructed along the curbs and across the street every 30 feet, all joints being protected with the Baker armor plate, which consists of a flat piece of steel about 3/16-inch thick and 2½ inches wide, bent to conform to the shape of the finished pavement. Two plates are used in each joint and are separated from ¼ to ⅜ inch. They are held in place by means of shear members which occur about 12 inches apart and are bent back at right angles to the plate and extended into the concrete. This pavement was designed by the writer, the contractor being James A. McKay, of Clare, Mich.

Vitrified Sewer Pipe Tests

Following are the results of tests as conducted by the Bureau of Sewers, Borough of Brooklyn, City of New York, upon a quantity of vitrified sewer pipe, varying in diameter from 24 inches to 42 inches. The manner of carrying out these tests is very similar to the method described by Dr. Gary and commonly known as the German method. The pipe was manufactured by the Blackmer & Post Pipe Company, of St. Louis, Mo., and was tested as called for in Brooklyn's specifications, as follows:

External crushing test. When supported upon a bed of thoroly compacted sand of such dimensions and in such manner that an even bearing is provided thruout the whole length, but without appreciable displacement of sand at the sides the various sizes of pipe shall withstand the following pressures applied at the crown uniformly along a line 1 inch in width and extending the whole length of the pipe exclusive of the bell.

V=A=N=D=O=R=N

METAL OFFICE FURNITURE

For Public Buildings, Court Houses, City Halls and Post Offices

Insures Real Protection Against Fires, Thieves, Meddlers and Carelessness

Simplifies and Keeps your Systems Uniform which means Highest Efficiency and Greatest Economy

Enclosed Type Library Shelves and Mezzanine Floor,
Law Library, Shelby County, Memphis, Tenn.
Jas. Gamble Rogers (of Hale & Rogers, Architects).

Let Us Show You that it Will Pay

——To Have Your New Equipment
——"BUILT TO YOUR SPECIFICATIONS"
——Without the Extra Cost.

The unique and structural designs afforded by Van Dorn patents insure the widest range of choice and the greatest degree of elasticity at the smallest cost—our engineers will be pleased to help you plan your systems according to your desires and suggestions.

Located in the heart of the iron and steel manufacturing district of the United States, we get the very best materials at low cost, and we employ only first-class mechanics, case-makers and finishers. We have a factory and equipment devoted exclusively to the manufacture of steel office furniture, in charge of men who have been with us since the beginning of the metal furniture industry, who in fact have grown with the business and made it what it is.

CATALOG "M" ON REQUEST.

THE VAN DORN IRON WORKS COMPANY

METALLIC FURNITURE DEPARTMENT

General Office, CLEVELAND, OHIO.

Diameter.	Pressure per Lin. Ft.
6 inches	1,000 lbs.
8 inches	1,000 lbs.
9 inches	1,050 lbs.
10 inches	1,100 lbs.
12 inches	1,150 lbs.
15 inches	1,300 lbs.
18 inches	1,450 lbs.
20 inches	1,600 lbs.
22 inches	1,800 lbs.
24 inches	2,000 lbs.
30 inches	2,700 lbs.
36 inches	3,300 lbs.
42 inches	3,800 lbs.

"These tests," states Mr. Edwin J. Fort. Chief Engineer of Sewers, "were all made with a knife edge placed parallel to the axis of the pipe. As to what the crushing strength of this pipe would have been had the pressure been applied equally to the upper half of the pipe, the lower half being imbedded in sand, I will state that I have worked out the information in accordance with a complete analysis of this and similar problems made by me while a student at Cornell University and later by Prof. Talbot of the University of Illinois.

The following formulae were used in making the calculations, the knife edge load assumed as a concentrated load along the crown of the pipe:

e and f=Extremities of vertical axis.
g and h=Extremities of horizontal axis.
p=concentrated load per foot of length.
d=distributed load per square foot of diametral projection.
a=mean diameter of pipe from neutral axis of walls.
M=bending moment.

Formulae.

Bending moment for concentrated load.
Me=Mf=.16 pd.
(By Me, Mf, Mg, etc., is meant bending moment at e, f, g, etc.)
Mg=Mh=.09 pd.
Bending moment for distributed load:
Me=Mf=Mg=Mh
$=1/16\ pa^2$.

The following table gives the results obtained:

A=Nominal diameter in inches.
B=Average wall thickness in inches.
C=Failed at in. pounds per linear foot under knife edge test.
D=Bending moment at e.
E=Heigbt of column of earth weighing 100 lbs. per cu. ft. carried on pipe to give same bending moment for distributed load as given in column C.
F=Same as Col. E, earth weighing 125 lbs. per cu. ft.
G=Total load distributed per linear foot of pipe to produce moment in Col. D.

Columns E and F, showing the depth of the column of earth, weighing respectively 100 and 125 pounds per cubic foot, which the speciemns tested would have supported, do not provide for any lateral support , which the pipe always receives from the earth which is rammed about it when it is laid, but which is very uncertain in amount. No allowance has been made also for the arching effect of earth in the trench, which nearly always takes place, but which is also uncertain in amount. The most extreme case which could happen is considered, that is, the earth in the trench is of such a character that its whole weight is transmitted to the pipe and no lateral support is received.

Hundreds of miles of vitrified sewer pipes of all sizes have been laid in Brooklyn, under all kinds of conditions, with the most satisfactory results.

After careful observations made of the vitrified clay sewer pipe in a number of European cities, Mr. Fort is positive that double strength pipe, such as is manufactured by a number of the largest companies in this country, is of a high degree of excellence, and is not inferior to the best pipe of this kind that is produced anywhere.

A	B	C	D	E	F	G
24-inch Std.	1 9/16	2420	825	28.50	22.5	6424
24-inch D.S.	2 1/16	3150	1090	36.5	29.0	8642
27-inch Std.	2¼	3875	1531	40	32	10670
27-inch D.S.	2 9/16	5183	2090	53	42	14340
30-inch Std.	2 7/16	4767	2081	45	35.5	13110
30-inch D.S.	2¾	4167	1890	38.5	31.0	11550
33-inch Std.	2 9/16	4433	2102	38.5	30.5	12170
33-inch D.S.	3	5658	2692	47.5	38	15680
36-inch Std.	2 9/16	4483	2320	35.5	28.5	12240
36-inch D.S.	2¾	5516	2868	43.5	35	15070
42-inch D.S.	3½	4967	3071	33	26.5	13683

Mixing of Concrete

By Creosoted Wood Block Paving Company, Dallas, Texas.

The mixing of concrete should be done as rapidly as possible and it should not be mixed in larger quantities than is re-

SARCOLITHIC MINERAL RUBBER

THE IDEAL PAVEMENT

IT IS ALWAYS DURABLE
NOISELESS – SANITARY – ECONOMICAL
WATERPROOF AND DUSTLESS
INVESTIGATION INVITED

SARCO

Standard Asphalt and Rubber Co.

137 So. La Salle St. CHICAGO.

Sarcolithic Mineral Rubber Pavement, Springfield, Mo.

quired for immediate use. We have made it a point to exercise great care in the mixing of concrete and see that it is thoroughly mixed and not permitted to appear raw when deposited in the forms. The materials should be mixed wet enough to produce a cement of such a consistency as will flow into the forms and about the metal reinforcing, when used, and which on the other hand, can be conveyed from the mixer to the forms without separation of the coarse aggregate from the mortar. In other words, the consistency of the concrete should be soft and wet without being sloppy, and in general should be such that after dumping the concrete into the forms it may be consolidated and worked into place with spades and shovels and a slight quaking secured with little or no effort. A good concrete worker can tell whether the concrete permits of easy

"BIG-AN-LITLE" *concrete mixer in use at Dallas, Tex., for construction of concrete curbs and gutters.*

tamping. The mixture should be moderately wet. Care, however, must be taken that the concrete is not too wet, so that the stone and sand settle under the water during its transfer to the forms, altho what is usually known as the wet mixture should be used for all reinforcement work.

For ordinary work, concrete should be mixed wet, soupy. From the standpoints of quality, ease of handling and manipulation, resulting finish, and the cost of surfacing there is absolutely no question as to this point. This choice of wet concrete applies to walls, bridges, reinforced buildings, etc., but for sidewalk and pavements economy demands a dry mixture requiring tamping, in order that the workmen applying the finishing may follow as quickly as possible after the depositing of the concrete.

No concrete should be placed until it is definitely determined that the forms are correct and properly braced. It is cheaper to delay the work than to cut out work already done. Concrete should be placed as quickly as possible after mixing and not be disturbed thereafter. The placing of concrete is one point where the material is abused to the greatest extent. We take great care of a green brick wall but do not hesitate to walk over and conduct operations over concrete which has not reached its final set, thereby destroying the surface of the concrete for all time.

Various types of work naturally demand various types of machinery and arrangement, but in general it may be said that too large a mixer is not economical. Use preferably nothing smaller than 4½ cubic foot mixer, which will deliver up to 50 yards of mixed concrete per day. Only use a larger mixer than this if work will justify it. Also, in general, it may be stated that each batch from the mixer should be handled as a whole as nearly as possible to the place of deposit. The wheelbarrow is no longer the primary method of transportation of concrete. There is no doubt as to majority of opinion being in favor of batch mixers, but whatever type is adopted, it would be well in the long run to make sure that the engine is of sufficient power to handle real work with ease.

We use a 4½-cubic foot per batch mixer wherever possible, having found that this size machine is easily moved by its crew from and to different parts of the work during its construction. A number of batch mixers of this size could be more profitably employed on large work than a machine of greater capacity.

In our concrete curb and gutter work, we easily average 450 lineal feet of 30 cubic yards per day with a crew of five feeders and three wheelers. We shovel direct into the mixer, but later on will add to our mixer the automatic loader, which will increase its capacity nearly 50 per cent. The average time consumed in producing each batch is 2½ minutes, most of which time is at present taken up with the loading. Before the adoption of machine mixing, we secured very uniform results by the hand method but at a considerably greater cost. Our mixers are of the 'Big-an-Litle' type and were furnished us by The Jaeger Machinery Company, of Columbus, Ohio.

LUTZ SURFACE HEATER

(It discounts ordinary cost bills 48%)

Resurfacing asphalt pavement on Bedford Avenue, Borough of Brooklyn, New York. Work done by Lutz Surface Heater operated by Municipal Asphalt Plant, City of New York.

H. H. SCHMIDT, (Chief Engineer Borough of Brooklyn, City of New York)
STATES:

"We operate four Lutz Surface Heaters—the resurfacing of asphalt pavements which, through age and wear and tear are beyond ordinary repair, can be most economically done with these machines."

The LUTZ SURFACE HEATER

softens asphalt and other bituminous pavements. It vulcanizes the old and new material into a perfect weld. It cements asphalt on granite, brick, cobble or other hard pavements. It makes resurfacing and maintenance easy and inexpensive.

Equitable Asphalt Maintenance Co.

Commerce Building. **Kansas City, Mo.**

Illustrated particulars on request.

Nearly all cities have condemned the use of all machines forcing the flame upon the pavement because of the destructive effect of intense heat, and the **Lutz** *method should not be confounded with these destructive appliances. The result of the work done through this principle has been highly satisfactory in every city where it has been used.*

M.E.

Mechanical Trench Filling

By G. M. Gest, Engineer and Contractor, New York City.

The backfilling of trenches is a troublesome problem on work in paved streets, owing to the difficulty of getting the fill so thoroly tamped that there will be no settlement of the paving when relaid over the trench. This problem is encountered by contractors and municipal authorities as well as by engineers, but with the class of labor commonly employed, it is not easy to get the work done well or in the way specified.

Municipalities should require that all back-fills be mechanically tamped, but the following requirements are usually noted in specifications:

1. The trenches are to be refilled by contractor. No specifications stating manner of doing the work. The only clause possibly covering this is the later section of "General Stipulations," where the streets are to be put in as good condition as contractor finds them when commencing work. This clause is generally inserted even when the manner of refilling is specified.

2. To be refilled by shovel and tampers to be used in the trenches. The requirements vary from two tampers to each shoveler or two shovelers to each tamper. Sometimes there may be an equal number of each.

3. Refill the trench to a depth of 1 to 3 feet above the pipe, fill the trench to the top with water and put in the remainder of the material. This is the only proper method for sand and gravel, but an improper method for clay or any earth containing much clay.

4. The trenches shall be refilled and then flushed by the city employes, or by the contractor, in order to settle the trenches.

In specifications like the first and second, it is sometimes required that the filling be put in dry or nothing is said about its condition. Sometimes it is required that the earth be moistened as it is deposited and occasionally it is required to be moistened on the bank before it is shoveled in and tamped. When the prescription of method is followed by the rider that the streets be restored to their former conditions, the contractor is put to a disadvantage, because the method specified may be one that is not suited to the material and it is impossible to restore the streets. When this is coupled with a provision that the contractor shall maintain the street for 12 months from the date of accentance, the injustice is extended beyond the contractor to the property owners who pay for the work.

The first method, simply requiring the trenches to be refilled and that the contractor put the streets in as good condition as before he touched them, should serve all purposes, provided it was required that the back-fill was to be mechanically tamped.

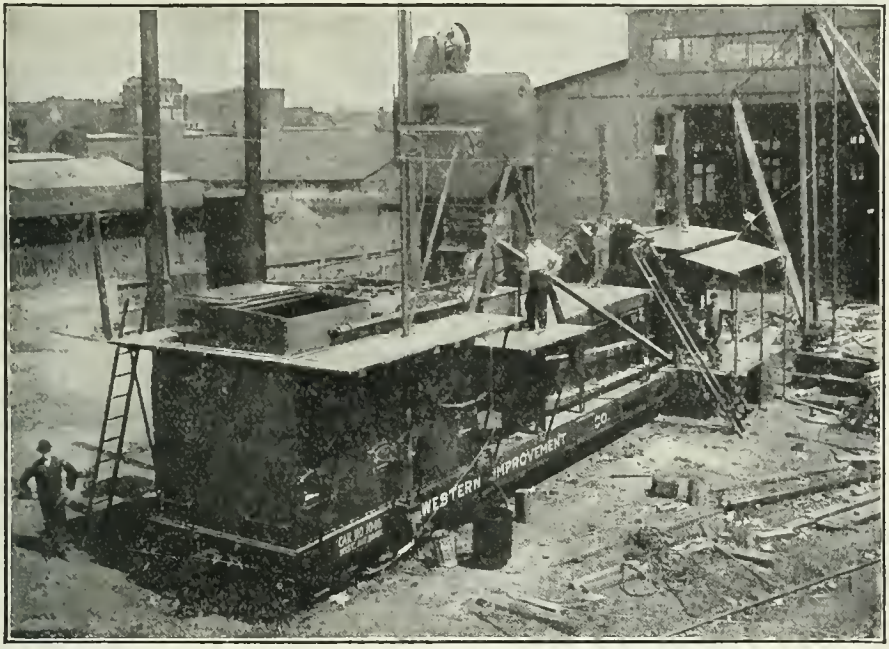
The method of back-filling by any old method and then flushing to settle the trenches is often slighted. Left to a lot of ignorant, unthinking laborers the method adopted is to push a hose clear down until it touches the pipe, turn the water on and go off to the nearest shady spot and sit down for awhile. Of course, the trench goes down, but future house connection work reveals queer looking lines of pipes with joints washed out and damaged stoppers in "Y's." Mechanical tamping, in our opinion, would solve all trench settling problems.

We make a specialty of conduit work and operate six tamping machines, as our experience has conclusively proven that mechanical tamping is far superior to any other method. We are operating these machines at a minimum saving of 50 per cent. over old hand tamping and flushing methods. These six Staley machines, which were furnished us by the Lourie Mfg. Co., Springfield, Ill., consist of two principal parts, the sweep on which is mounted the lifting mechanism, the engine and the two-wheeled truck on which the sweep is mounted. The sweep is built of two 3-inch steel channels, with the necessary spacers, bracing and truss rod, mounted near its center of gravity, on a saddle casting which has a bearing on a pivot on the truck axle. The sweep swings in a horizontal direction on this pivot, thus moving the tamper across the work, while the movement along the work is had by moving the track forward about 8 inches for each complete swing of the sweep. The truck has 4 by 36-inch steel wheels and a 1½-inch arched steel axle. The truck frame is formed of one piece of 2 by 2 by ¼-inch angle. The steel axle spindle is cast into a square socket thru which passes the vertical leg of the axle: the axle at this point is pivoted with about 8 inches of vertical adjustment, and a like amount of adjustment is provided in the cast-iron shoe on the bottom of the truck on the curb or other unlevel surface, and is a valuable feature when the machine is required to work close up to the curb.

New Kelly Power Dump

The Kelly Springfield Motor Truck Company, of Springfield, O., has recently placed on the market a new power dump body. The workings of this equipment are claimed to be distinct and different fro mthose of any other power dump body on the market today.

MODEL OF 1912 ONE-CAR PLANT.



1,000 SQUARE YARDS 2-INCH TOPPING PER DAY.

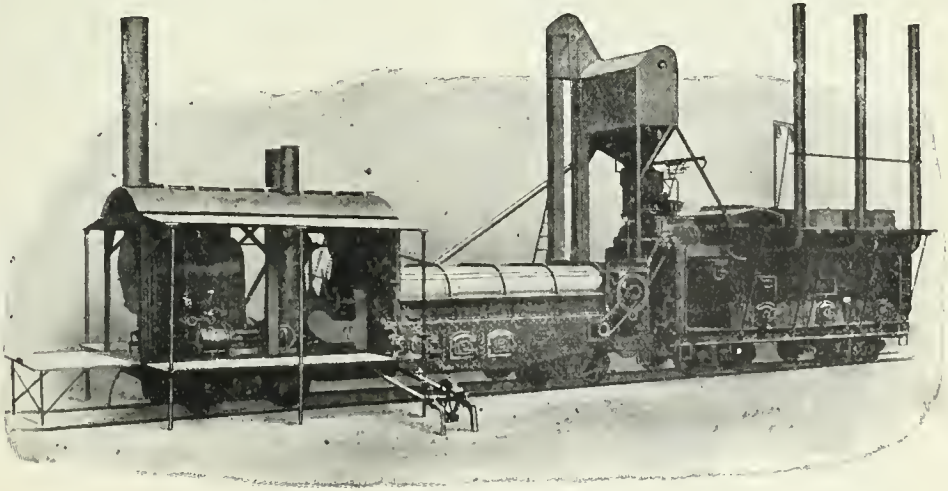
HETHERINGTON RAILWAY ASPHALT PAVING PLANTS

The product of 16 years experience in Plant Building by the originators of the first railway plant. **Still lead, are only safe railway plants made.**

THESE PLANTS HAVE NO EQUALS. WRITE FOR CIRCULARS.

HETHERINGTON & BERNER, - INDIANAPOLIS. IND.

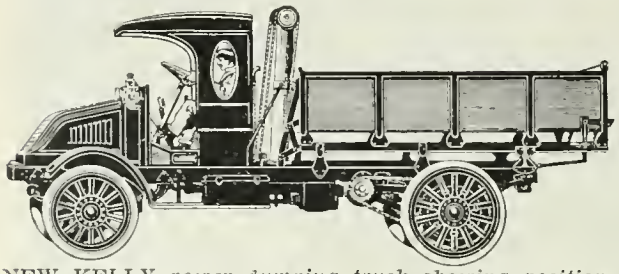
1,500 SQUARE YARDS AND 2,000 SQUARE YARDS PER DAY



MODEL OF 1912 TWO-CAR PLANT.

The Kelly dumping apparatus is of the hydraulic type and operated with oil. The hoisting device is manufactured by the Wood Hydraulic Hoist Co., of St. Paul, Minn., but the attachments to the body and power transmitting and operating devices are the products of the Kelly engineers.

The device has for its chief component a large size steel cylinder, 6 inches in diameter, inside of which works a conventional type piston with two piston rings on it. The piston is attached to a 2-inch diameter steel piston rod, which extends thru the upper cover flange of the cylinder. To the upper end of this piston rod are attached two steel pulleys to guide the two wire ropes. The back end of each of these wire ropes is fastened to the lifting nose of the steel body; the other end is solidly fastened to a strong equalizer, which insures equal tension on both ropes. This insures that the lifted load is always carried on both ropes.



NEW KELLY *power dumping truck showing position of dumping mechanism prior to lifting of the body.*

A gear pump is fastened to the cylinder base and is driven by means of proper size chains and sprockets from an extension of the transmission countershaft. The pump is driven three times the engine speed. This is done so that the operator will not race the motor when lifting load. Three hundred revolutions of the motor will lift the 3-ton load and bring the body back to its seat in about one minute.

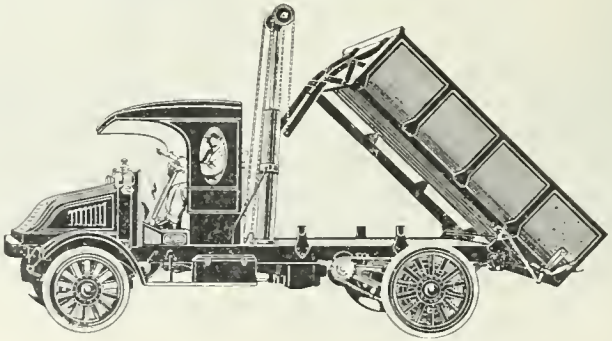
The pump mechanism is controlled directly at the driver's right hand on top of the driver's seat. The operator simply disengages his clutch, just the same as he does to shift speed gears. In doing this, the countershaft of the transmission is brought to a standstill and the lever at the right hand of the driver is pulled in place. The power connection is now accomplished.

The engagement of this extension of the countershaft is locked in a similar manner to the sliding bars of the conventional type sliding-gear transmission. This positive lock enables the driver to leave his seat with the device engaged until he gets thru with dumping.

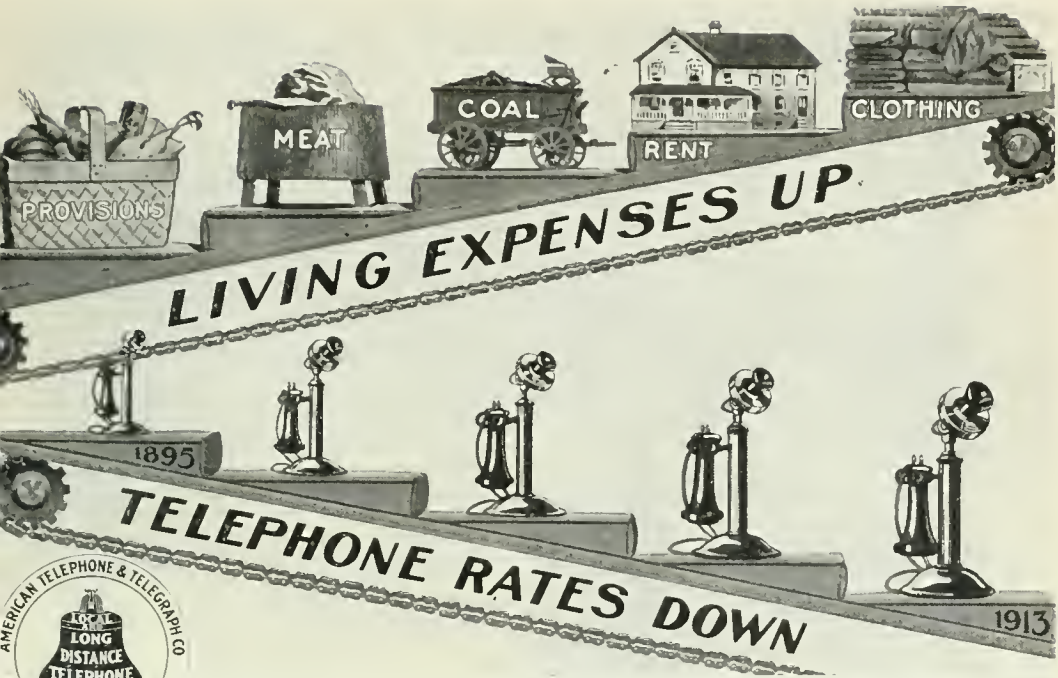
After engaging the power connection the driver may step off, walk back to the machine and open the tail gate, then walk forward to the back seat on the right hand side of the machine. Here is a hand lever which controls the action of the power hoist proper.

By pushing this lever away from himself the hoist will lift. When the lever is in a vertical position the hoist is at a standstill, and by pulling the lever toward himself, the hoist lowers. When the entire body, therefore, is brought back to its seat, the driver may step up to the steering gear, disengage his clutch, pull the power hoist operating lever at his right hand in neutral position, and is ready to move on with his truck.

It is readily conceivable from the above description that the driver of the truck as well as the entire operation of the dumping machinery is but a one-man job. The whole equipment is designed and built with the same characteristic staunchness and simplicity which is so consistently carried out in all Kelly designs.



POSITION *of dumping apparatus when truck body is completely elevated for dumping. Entire mechanism controlled from driver's seat.*



Economy of the Bell System

Consider this significant fact: While most of the necessaries of life have gone up, the price of telephone service, which is one of the essential factors in our commercial and social life, has moved steadily downward.

Although a pound of these necessities still contains but sixteen ounces, the telephone user has been getting more and more service for less money.

On the average, the people of this country pay 49% more today for food, fuel and clothing than they did in 1895. Since then, the decrease in the average rates for telephone service has been more than one-half.

At the same time, the efficiency and value of the service to the subscriber has vastly increased. Today he can talk to an average of five times as many persons in each exchange as he could eighteen years ago.

This is the inevitable result of the comprehensive policy of the Bell System, which brings together the associated Bell companies and the communities they serve.

Through the very size and efficiency of their organization they accomplish improvements and effect economies which give the greatest service at the lowest rates.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

Concrete Chimney Construction

Reinforced concrete is becoming a most popular material for the construction of all chimneys for power house, smelter, malleable iron furnaces, blast furnaces and in fact every purpose for which tall chimneys are required.

It is good practice to compute a chimney for 50 pounds per square foot wind pressure; this represents a maximum velocity, and is a conservative basis on

REINFORCED *concrete chimney constructed for Lehigh Portland Cement Co. at Mason City, Ia. Total height 208 feet 9 inches.*

which to figure. The importance of a chimney in connection with any plant, is such a great factor that it is most important that the chimney be in service or ready for service at all times.

The formula of Turneaure & Maurer, of the University of Wisconsin, as published in "Principles of Reinforced Concrete Construction," 1910 edition, is considered the highest authority on the subject of designing and calculating the stresses in reinforced concrete chimneys.

One of the tallest chimneys in the United States is of reinforced concrete construction and is located in Butte, Montana. It was constructed in 1905 for the Colusa Parrott Mining and Smelting Company and was built by the Weber Chimney Company, of Chicago. Another large chimney of the coniform type, built by the Weber Chimney Company, was constructed recently at Mason City, Iowa, for the Lehigh Portland Cement Company. This chimney, which is illustrated herewith, is 208 feet 9 inches high from the base of the foundation, foundation being 6 feet 9 inches below grade. The width of the square part of the foundation is 25 feet 6 inches, greatest thickness of foundation being 5 feet 9 inches, inside diameter at the top of chimney 10 feet 6 inches, tapering to largest outside diameter at base of chimney of 16 feet 2½ inches. This chimney is lined with a reinforced concrete lining to a height of 66 feet 6 inches. The wall at the top is 5 inches thick increasing to 19⅞ inches at the base of shaft. This chimney is guaranteed to be capable of withstanding wind pressure of 50 pounds per square foot and the influence of the atmosphere and chimney gases.

Trade Notes

Nels Erickson, 405 Boston Block, Minneapolis, Minn., will handle the Chain-Belt concrete mixer and other concrete machinery in the city of Minneapolis and vicinity.

The Southern Clay Manufacturing Co., of Chattanooga, Tenn., W. M. Lasley, president, has been licensed by the Dunn Wire-Cut-Lug Brick Co., to manufacture wire-cut-lug brick in their three plants at Robbins, Tenn., Coaldale, Ala., and Chilhowie, Va.

The sixth annual directory of trade and technical publications, 20 cents, is ready for distribution by *Advertising and Selling*, 95 Madison Ave, New York City.

The McCormick Waterproof Portland Cement Co., Chicago, Ill., selling shamrock brand waterproofing compound, has been reorganized with James A. Smith as president and general manager, former president Charles McCormick being no longer connected with the company in any official or authoritative capacity.

H. W. Johns-Manville Co., have opened a new office and warehouse in Galveston, Tex., the third in that state, where heavy shipments will be received by steamer, particularly to the Texas territory and to Central and South American points.

The Mullen apparatus for drying and heating gravel and stone on the street for use in bituminous pavements or for heating stone for concrete, which has been in successful use for several years and is well and favorably known has been

Huber Gas Tractors

Huber Gas Tractors Grading and Hauling for Streets of Speedway City, Ind. (Much of the time running 24 hours per day.) C. C. King Brother & Son, Contractors.

Are Building the Streets of the New "Million Dollar City"

Three Huber "Thirty-Sixty" Gas Tractors

—are **carving a complete town out of an open piece of farm land** near Indianapolis at **exceedingly** low cost.

—are hauling in **faster** time, **twice** as many **heavier** loaded carts per unit of power than horses at gasoline **cost less** than expense of feed for horses to do same work.

—are **saving the expense of at least ten men per outfit** compared with horses and wagons.

"Grading for a $1,000,000.00 City"

is the title of a folder

SENT FREE ON REQUEST

The utility of this "Thirty-Sixty" tractor for contract work is unquestioned. It has speed and power, both essential to handling a big contract profitably. The traction wheels are eight feet high. This gives it an unusually strong grip on the ground, makes it a strong puller, and enables it to travel over soft surfaces that would be difficult to cover otherwise. Either gasoline or kerosene may be used as fuel with equally good success.

HUBER COMBINATION ROAD BUILDERS ARE BIG MONEY SAVERS

The Huber Manufacturing Co.

601 Center Street. **MARION, OHIO.**

Representatives for Eastern Canada, F. H. HOPKINS & CO., Montreal.

patented, the application for patent having been filed in 1910 and the patent issued Sept. 30, 1913. C. A. Mullen, superintendent of public works, Schenectady, N. Y., is the patentee.

E. U. Heslop is in charge of the new branch office of the H. W. Johns-Manville Co., at Charlotte, N. C.

The Raymond Concrete Pile Co., 140 Cedar street, New York, has received contracts for their concrete pile foundations from the Maryland Steel Company, Sparrows Point, Md., for a new gas engine building; for the grain elevator addition to the new brew house for the Los Angeles Brewing Co., Los Angeles, Cal.; for the new Standart Brothers building, Front street, Detroit, Mich; from the American Dock Company, 21 State street, New York City, for a new seven-story warehouse at Tompkinsville, Staten Island; from J. I. Case Threshing Machine Company, Racine, Wis., for their new branch warehouse at Kansas City, Mo.; for the new Riverside plant of the Otis Steel Co., Cleveland, O.; for the new church at Twenty-eighth place and Wallace street, Chicago; and for the new building for the Standard Oil Company at Buchanan, N. Y.

Trade Publications

Class M, Chicago pneumatic, Corliss type, steam-driven compressors are the subject of Bulletin 34-T of the Chicago Pneumatic Tool Co.

The latest catalog of the Western Wheeled Scraper Co., Aurora, Ill., shows the latest improvement in earth and stone handling machinery.

Integral Waterproofing Co., 50 Church St., New York, will send circulars showing the extent of the use of Keystone waterproofing compound for concrete in fresh and salt water and reproductions of letters from satisfied users.

The Independence Brick Co., Independence, Kan., is sending out an A B C card, the A standing for the asphalt filler furnished by the Standard Asphalt and Rubber Co., the B for the paving brick made by the Independence Brick Co., the C for portland cement made by local mills, and the whole card for the brick pavements of Independence "the cleanest town in Kansas."

The Universal Portland Cement Co. has issued a number of pamphlets on the use of cement during the past summer, among which are "Specifications for Construction of One-Course Concrete Street Pavement," "Specifications for Construction of One-Course Concrete Highway," "Specifications for Two-Course Concrete Street Pavement," "Concrete in the Barnyard," "Small Concrete Bridges and Culverts," "Concrete Highway Bridges," "Concrete Silos," "Concreting in Cold Weather," "Concrete Surfaces," "Cement Drain Tile," "Small Farm Buildings of Concrete," "Concrete Pavements, Sidewalks, Curb and Gutter."

The Barber Asphalt Paving Co., Philadelphia, Pa., is demonstrating the applicability of Trinidad Lake asphalt to use in roofing cements and will send on request circulars concerning the product and specifications for standard 4-ply Trinidad Lake asphalt roof to be applied over boards, and to be applied over concrete or hollow tile.

"The Kennicott Company," by Elbert Hubbard, tells the story in entertaining form of the company and its water softeners.

Continental automobile fire apparatus is described in an illustrated booklet of the Ahrens-Fox Fire Engine Co., Cincinnati, O.,

"Harvest Time," is the title of a booklet of the Koehring Machine Co., Milwaukee, Wis., describing their concrete mixers as used by paving contractors.

Catalog 60 of the Van Dorn Iron Works Co., Cleveland, O., shows their joist hangers, port caps and bases for all kinds of uses.

E. G. Soltmann, New York, send samples of reproductions by their new inkograf process.

"The Wonderland of Trinidad," is the title of an elaborately illustrated bookleet issued for free distribution by The Barber Asphalt Paving Company, Philadelphia. The text and pictures are confined to description of the island of Trinidad, its asphalt lake and the mining and handling of asphalt up to the refining stage. This is the first publication in any form that gives an adequate idea of the natural wonders of an asphalt lake, its formation and the physical conditions surrounding such deposits.

The eleventh edition of the Hy-Rib Handbook has just been issued and contains many additions, including the new seven-rib hy-rib and the applications of hy-rib to such structures as the dome of the Cuban president's palace, at Havana, a large concrete railroad culvert, the passageway at the Wayne county home and the like, with full specifications for all uses, details of connections, etc.

Catalog 10 of Raymond Brothers Impact Pulverizer Co., Chicago, Ill., is devoted to their grinding, pulverizing and separating machinery.

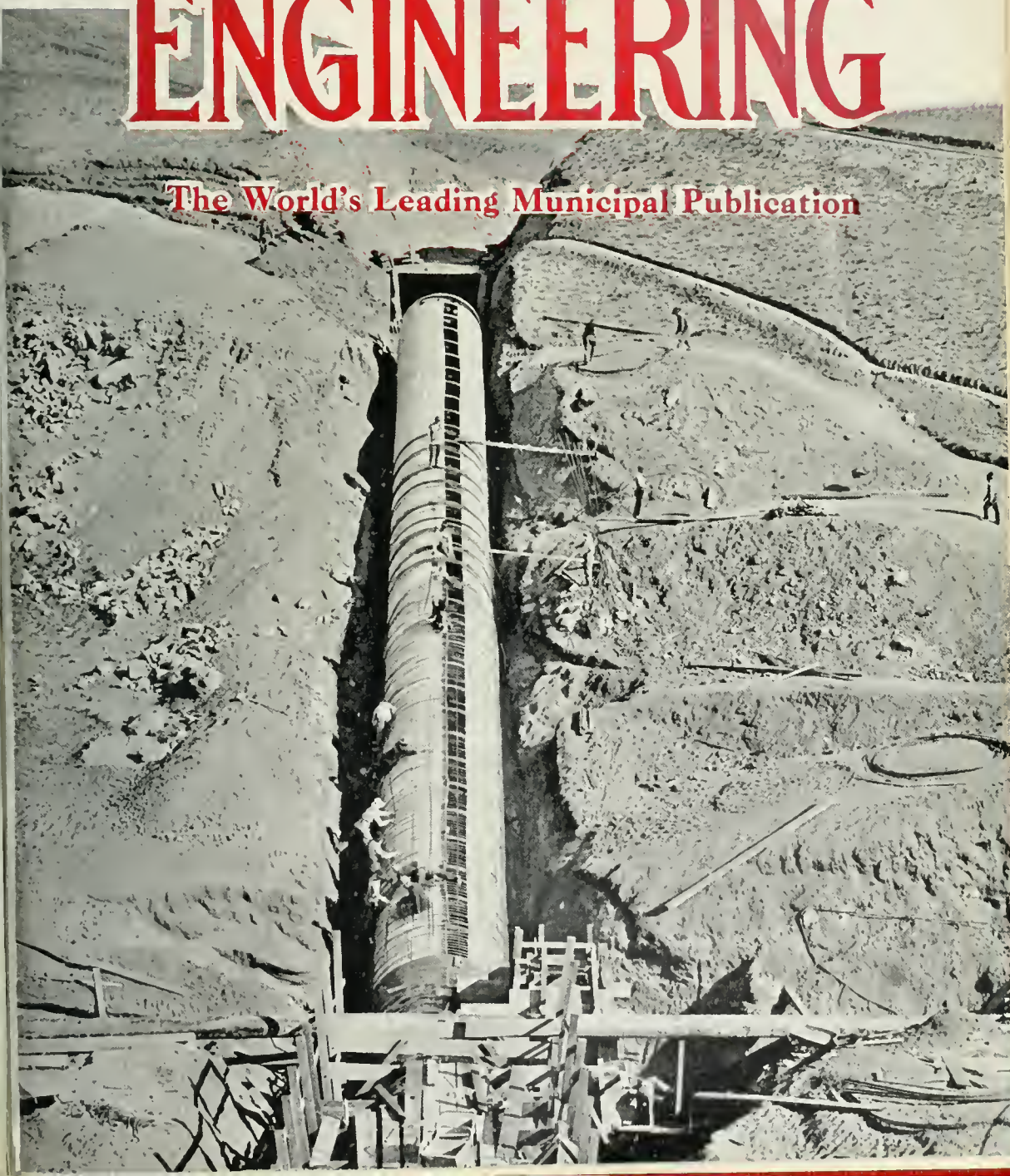
The largest railroad terminal in the world and how it is waterproofed are shown in a recent publication of the Barrett Mfg. Co.

Some test data on fireproof floor construction, relating to cinder, concrete, terra cotta and gypsum, are given in a recent publication of the Clinton Wire Cloth Co., Clinton, Mass.

Vol. XLV. No. 6. December, 1913. Twenty-five Cents.

MUNICIPAL ENGINEERING

The World's Leading Municipal Publication



The Triumph Adding Register

Modern business uses up-to-date time and labor saving equipment not merely to save time and labor, but to **insure accuracy.** The cash register, the adding machine, the calculating machine and dozens of standard and special types of equipment have been devised for making the work of the individual more accurate and complete. Modern business takes no chances, and the business that uses old time methods doesn't last long.

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¶ The **Triumph** is accurate. It can not fail to record each vote exactly as cast.

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BITUMINOUS CONCRETE HIGHWAY, *Chalmers and Liberty Streets, Mercer County, Trenton, N. J. This type of pavement is being used quite extensively through New Jersey and is proving successful.*

VOL. XLV. DECEMBER, 1913. No.6.

A man well known in advertising circles recently told how he "swiped" an idea and adapted it to his own ends. The idea was suggested in an article read by another advertising man of prominence at a convention. This little idea is now being used by the man who was shrewd enough to see its value, as the keynote of a campaign of large size. This is another illustration of the value of keeping abreast of the times by reading and keeping constantly informed of the ideas others are developing. The man who searches for ideas is usually a good lap ahead of his contemporaries. MUNICIPAL ENGINEERING *is the "World's Leading Municipal Publication" and the one magazine which will keep you alive to the progress of the large field it covers.*

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TWELVE YEARS OF COMMISSION GOVERNMENT

By E. S. Bradford, Washington, D. C.

Mr. Ernest S. Bradford is the author of "Commission Government in American Cities," which is the standard book on this form of municipal administration. He is a member of the committee on commission government of the National Municipal League and one of the experts chosen by the city of Los Angeles to confer with its charter commission in preparing the proposed new form of government for that city. His history of the movement is, therefore, authoritative, and his criticisms of the defects in the commission plan and his comparisons of it with the city manager plan will have great weight on that account.

NOT one of those who were present when the Texas legislature granted a new charter to the city of Galveston, April 19, 1901, imagined that the date was to become nearly as historic in municipal government as April 19 had proved in other years, in the general field of American history. The commission form, accepted prior to 1908 by only eleven cities in six states,—Texas, Iowa, Kansas, South Dakota, North Dakota and Idaho,—was adopted in that year by seven additional cities; in 1909 by no less than fifteen others; and in the years since, by an ever increasing number, until Oct. 1, 1913, about three hundred municipalities of varying sizes and in all sections are operating or about to operate under this plan of government.

Cities of 100,000 population are represented by Memphis (131,105), Oakland, Cal. (150,124), Spokane (104,402), Birmingham (132,685), Omaha (124,096), Trenton (96,815, in 1910), Salt Lake City (92,777, in 1910), Lowell, Mass. (106,294), Dallas (92,104, in 1910), and more recently, St. Paul (214,744), and New Orleans (339,075). Los Angeles voted down (in December, 1912) what was probably the most carefully prepared commission charter up to that time, but for wh people appeared not yet to be ready. Pittsburg and Boston have already in operation revised charters approaching the commission form. Portland, Ore., also Denver, Colo., and Jersey City have voted since Jan. 1, 1913, to adopt the small-board plan.

Of commission governed centers of over 50,000, Mobile, Oklahoma City, Lawrence, Mass., Atlantic City, Passaic and Duluth are among the more recent additions to the list, while earlier names in this class include Lynn, Mass., Fort Worth, Houston, Tacoma, Des Moines, Kansas City, Kan., and Springfield, Ill. It is interesting to notice the location and the size of the commission governed cities, in the accompanying list, which is approximately complete up to October 1, 1913, tho constantly receiving accessions.

Alabama—	
Birmingham	132,685
Cordova	1,747
Hartselle	1,374
Huntsville	7,611
Mobile	51,521
Montgomery	38,136
Sheffield	4,865
Talladega	5,854
Tuscaloosa	8,407
Arizona—	
Phoenix	11,134

Arkansas—
- Fort Smith 23,975

California—
- Berkeley 40,434
- Modesto 7,258
- Monterey 4,923
- Oakland 150,174
- Pasadena 30,291
- Sacramento 44,696
- San Diego 39,578
- San Luis Obispo 5,157
- San Mateo 4,384
- Santa Cruz 11,146
- Stockton 23,256
- Vallejo 11,340

Colorado—
- Colorado City 4,333
- Colorado Springs 29,178
- Denver 213,381
- Durango 4,686
- Fort Collins 8,210
- Grand Junction 7,754
- Pueblo 44,395

Florida—
- Lakeland 3,719
- Pensacola 22,982
- St. Petersburg 4,127

Georgia—
- Cartersville 4,067

Idaho—
- Lewiston 6,043

Illinois—
- Cairo 14,548
- Carbondale 5,411
- Clinton 5,165
- Dixon 7,216
- Decatur 31,140
- Elgin 25,976
- *Forest Park 6,594
- Hamilton 1,627
- Harrisburg 5,309
- Harvey 7,227
- Hillsboro 3,424
- Jacksonville 15,326
- Kewanee 9,307
- Marseilles 3,291
- Murphysboro 7,485
- Moline 24,199
- Ottawa 11,121
- Pekin 9,897
- Rochelle 2,732
- Rock Island 24,335
- Springfield 51,617
- Spring Valley 7,035
- Waukegan 16,069

Iowa—
- Burlington 34,324
- Cedar Rapids 33,811
- Des Moines 86,368
- Fort Dodge 15,543
- Keokuk 14,008
- Marshalltown 13,374
- Mason City 11,230
- Ottumwa 22,012
- Sioux City 47,828

Kansas—
- Abilene 4,118
- Anthony 2,669
- Arkansas City 7,508
- Caldwell 2,205
- Chanute 9,272
- Cherryvale 4,304
- Coffeyville 12,687
- Council Grove 2,545
- Dodge City 3,214
- Emporia 9,058
- Eureka 2,333
- Garden City 3,171
- Garnett 2,334
- Girard 2,446

THE DES MOINES COMMISSION *and their secretary. This is a managing commission, each member having charge of a department with one member acting as chairman and official head with title of Mayor, but no increase in power or responsibility.*

- Great Bend 4,622
- Hiawatha 2,974
- Holton 2,842
- Hutchinson 16,364
- Independence 10,480
- Iola 9,032
- Junction City 5,598
- Kansas City 82,331
- Kingman 2,570
- Lawrence 12,374
- Leavenworth 19,363
- Manhattan 5,722
- Marion 1,841
- Neodesha 2,872

Newton	7,862
Olathe	3,272
Ottawa	7,650
Parsons	12,463
Pittsburg	14,755
Pratt	3,302
Topeka	43,684
Wellington	7,034
Wichita	52,450
Kentucky—	
Covington	53,270
Lexington	34,099
Newport	30,309
Louisiana—	
Alexandria	11,213
Baton Rouge	14,897
Donaldsville	4,090
Hammond	2,942
Jennings	3,925
Lake Charles	11,449
Natchitoches	2,532
New Iberia	7,499
New Orleans	339,075
Shreveport	28,015
Mankato	10,365
Duluth	78,466
‡St. Cloud	10,600
St. Paul	214,744
Mississippi—	
Clarksdale	4,079
Gulfport	6,386
Hattiesburg	11,733
Jackson	21,262
Laurel	8,465
Meridian	23,285
Vicksburg	20,814
Missouri—	
Joplin	32,073
Montana—	
Missoula	12,869
Nebraska—	
Beatrice	9,356
Lincoln	43,973
Nebraska City	5,488
Omaha	124,069
New Jersey—	
Atlantic City	46,150

JUDGE WILLIAM T. AUSTIN, *the first president of the Galveston Commission.*

JUDGE LEWIS FISHER, *the Mayor-President of Galveston, Texas.*

Maine—	
Gardiner	5,311
Maryland—	
Cumberland	21,839
Massachusetts—	
Gloucester	24,398
Haverhill	44,115
Lawrence	85,892
Lowell	196,294
Lynn	89,336
Salem	43,697
Michigan—	
Battle Creek	25,267
Bay City	45,166
Fremont	2,009
Harbor Beach	1,556
Pontiac	14,532
Port Huron	18,863
Traverse City	12,115
Wyandotte	8,287
Minnesota—	
Faribault	19,001
Beverly	2,140
Bordentown	4,250
Haddonfield	4,142
Hawthorne	3,400
Jersey City	267,779
Long Branch	13,298
*Millville	12,451
Nutley	6,009
Ocean City	1,950
Passaic	54,773
Ridgfield Park	
Ridgewood	5,416
Trenton	96,815
Vineland	5,282
Wallington	3,448
New Mexico—	
Las Vegas	3,719
North Carolina—	
Greensboro	15,895
*Hickory	3,716
High Point	9,529
*Morganton	2,712

Raleigh	19,218
Wilmington	25,748
North Dakota—	
Bismarck	5,443
Devil's Lake	5,157
Fargo	14,331
Mandan	3,873
Minot	6,188
Williston	3,124
Ohio—	
*Columbus	181,511
*Dayton	116,577
*Sandusky	19,989
*Springfield	46,921
Oklahoma—	
Ada	4,309
Ardmore	8,618
Bartlesville	6,181
Collinsville	
Duncan	2,477
El Reno	7,872
Enid	13,799
Guthrie	11,654
Holdenville	2,296
Lawton	7,788
MacAlester	12,594
Miami	2,907
Muskogee	25,278
Oklahoma City	64,205
Okmulgee	4,176
Purcell	2,740
Sapulpa	8,283
Tulsa	18,182
Wagoner	4,018
Oregon—	
Baker	6,680
Portland	207,214
Pensylvania—	
Allentown	51,913
Altoona	52,127
Beaver Falls	12,191
Bradford	14,454
Carbondale	17,040
Chester	38,537
Corry	5,991
Easton	28,532
Erie	66,525
Franklin	9,767
Harrisburg	64,186
Hazleton	25,452
Johnstown	55,482
Lebanon	19,240
Meadville	12,780
McKeesport	42,604
New Castle	36,280
Oil City	15,657
Pittston	16,267
Reading	96,071
Titusville	8,533
Wilkes-Barre	67,105
Williamsport	31,860
York	44,750
South Carolina—	
Columbia	26,311
Florence	7,057
Spartanburg	17,517
*Sumter	8,109
South Dokota—	
Aberdeen	10,753
Belle Fourche	
Canton	2,103
Chamberlain	1,275
Dell Rapids	1,367
Huron	5,791
Lead	8,392
Madison	3,137
Pierre	3,656
Rapid City	3,854
Sioux Falls	14,094
Vermillion	2,187
Watertown	7,010
Yankton	3,787
Tennessee—	
Bristol	7,148
Chattanooga	44,604
Knoxville	36,346
Lebanon	3,659
Memphis	131,105
Springfield	2,085
Texas—	
Aransas Pass	1,197
Austin	29,860
Corpus Christi	8,222
Dallas	92,104
Denison	15,632
Fort Worth	73,302
Galveston	36,981
Greenville	8,850
Houston	78,800
Kennedy	1,147
Marble Falls	1,061
Marshall	11,452
McKinney	4,714
Palestine	10,297
Port Arthur	7,663
Port Lavaca	1,699
Utah—	
Salt Lake City	92,777
Logan	7,522
Murray	4,057
Ogden	25,580
Provo	8,929
Washington—	
Centralia	7,311
Chehalis	4,507
Everett	24,814
Hoquiam	8,171
North Yakima	14,082
*Spokane	104,402
*Tacoma	83,743
Walla Walla	19,364
West Virginia—	
Bluefield	11,188
Grafton	7,563
Huntington	31,161
Parkersburg	17,842
Keyser	3,705
Wisconsin—	
Appleton	16,773
Ashland	11,594
Eau Claire	18,310
Janesville	13,894
Ladysmith	2,352
Menominee	5,036
Oshkosh	33,062
Portage	5,440
Rice Lake	3,968
Superior	40,384
Wyoming—	
Sheridan	8,408
Cheyenne	11,320

* City Manager.
‡ In practice, should be included as commission plan.

The total is 311 cities, including eleven small towns in Texas and five in New Jersey, not incorporated, the populations of which are not given in the census report for 1910, and which are not enumerated in the list.

The characteristics which a charter must possess in order properly to be classed in the list of cities having the commission form are now pretty generally agreed upon. The presence of a single small board (usually five or less) as the directing and governing body of the city, elected at large, vested with substantially the entire municipal authority, and each member head of a department of the city's work, as in the Galveston

and Houston charters, has been coupled in the Des Moines and other later forms with one or more features of direct popular control, such as the full referendum, the recall, initiative and nonpartisan nominating primaries and elections. These have come to be regarded as necessary checks upon the exercise of the large powers granted to the small commission. There is frequently provided also, a municipal civil service board.

An analysis of the organic acts applying to our two hundred commission cities reveals the presence in the great majority of instances of all of the first named elements and most of the methods of popular control enumerated, whether in special charters or general acts; and this disposition is that of existing commission governments. We see, therefore, that the central fact of the commission form is its placing both administrative and legislative authority (so far as municipal authority may rightly be termed legislative) in the hands of a single small board, while as balancing "checks" there are usually provided such supplementary but essential features as the short ballot, election at large and division into departments, besides the means of direct control by the voters, as just mentioned.

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¶ COMMISSION *government has standardized the governing unit, made possible more efficient government and has concentrated authority and responsibility.*

Among students of municipal science and observers of existing civic conditions, there is general agreement as to the results secured under the commission charters. As might have been expected, placing five men in charge, each of about the same power, "standardized" the governing unit, as well as the candidate; centered public attention on the governing body and made it possible to select better men for office, on account of the small number of officials the voters had to pass upon, and their election by the whole city. City government was much simplified. Concentration of authority, coupled with the responsibility of the commissioners, which was enforceable by the recall and the referendum, has led to prompt and effective action by the "small council." Reports from the cities, in their various fields of activity, disclose pretty generally advances over the former municipal methods; nor has later and closer scrutiny changed materially the conclusions as to the progress already made, tho it reveals further needed improvements. Care in handling the city's funds, attention to streets, water supply and other public works, good policing and better fire and health protection, have been among the results of the establishment of the new form of govermental organization.

Floating debts or long outstanding bonds have been retired without the issue of new bonds, in Galveston, Houston, Leavenworth (Kan.) and elsewhere; back taxes have been collected; municipal funds on deposit in banks have been made to yield revenue; operating expenses have been diminished, receipts enhanced, better methods of accounting introduced, in cities too numerous to mention. At the same time more honest and vigorous efforts to suppress crime and vice have been manifested. Health departments report improved sanitary conditions in Dallas, Cedar Rapids, Houston, and many other cities. Fire departments, fairly efficient before, show less change. Cleaner streets, better lighting and water service, more paving, better bridges, are engineering items noted in Huntington, Haverhill, San Diego, Kansas City (Kan.), Austin, Des Moines and Berkeley. Partisanship in elections has been reduced; franchises guarded; city planning commenced. A great deal remains yet to be done in the way of efficiency accounting and in further planning for city growth and needs; but the work already accomplished has established the commission form as an improved type of municipal organization. "By 1911," says Henry Bruere, for example, in his book on "The New City Government," every student of American city government realized that the growing commission movement was not based upon vagaries, but on the very definite satisfaction which commission cities had found in the new plan."

THE GALVESTON COMMISSION *and its bureau chiefs. President Lewis and Police Commissioner Norman in foreground. Secretary Kelley at left end of table, City Attorney Kleberg, Commissioners Kempter, Lange and Austin seated behind the table.*

The question of present interest is no longer whether commission government has been successful or whether it should be adopted by our cities, but what modifications or improvements can be recommended to insure its best operation in our larger centers and what next steps these cities should take.

It will be well to recall briefly the steps thru which the commission form has developed before proceeding to consider the modifications proposed in the plan.

The "Galveston plan," or so-called original commission form, adopted in 1901, provided for a small board (five), with large powers, each member in charge of a department. At first, three members were appointed and two elected, but court decisions, holding such appointment unconstitutional, forced the amendment of the charter in 1903, and the election thereafter of the entire number of commissioners. The referendum and the recall were not included in the Galveston charter, except that the state law provides for a referendum on bond issues.

When Houston, the second city, adopted the plan in 1905, it accepted the main principles, as just noted, but made the mayor all-powerful by giving him a veto as mayor after he had voted in the commission, and the power of removal of city appointees without the concurrence of the "council"—the other four commissioners. Houston also provided a referendum on franchises and bond issues and certain minor features.

Then came the Iowa cities under a state law—Des Moines and Cedar Rapids the leaders in 1907. The "Des Moines Plan," as the Iowa law was dubbed, made the referendum applicable to all ordinances, and added the initiative, recall, nonpartisan primaries and elections, a civil service commission and other provisions. This was regarded as a marked step in advance, and the Iowa law has been more generally followed as a model than perhaps any other one commission act.

The commission charters recently adopted have contained most of the provisions of the Des Moines law, but there seems to have been a rather perceptible tendency toward some plan of preferential voting—a method by which the voter expresses not only his first choice for each commissioner, but his second and even his third choice, thus insuring that the men elected are the choice of a majority of the voters.

The most marked development of the past twelve months, however, has been the advent and advocacy of various "city manager plans. Under most of these plans, a single manager is chosen for the entire city, with power to appoint subor-

dinates and to take action as needed subject to some elected legislative or general executive body. The commission and city "manager" plans may all be grouped under several distinct heads:

I. "The Managing Commission" or "commission form," as it is generally known, under which a commission or small elected group direct and manage the affairs of the city. The commissioners are frequently of substantially equal authority, tho the mayor has usually supervisory power over the acts of the other commissioners. A variation of the commission form is the next, or

II. "Mayor-manager" plan, under which the mayor is clearly the most powerful member, as in Houston, Texas. This is accomplished by various means; in Houston, the mayor, as already seen, has both a vote as a member of the commission and a veto on its acts as a whole, as well as the power to remove city appointees (except the controller), with or without the consent of the rest of the commission. Where the mayor is all-powerful, there is no lack of unity in the commission; he can override opposition, and control largely both the municipal policy and its execution.

III. The "Council-Manager Plan." In this type, in operation before the commission-manager plan, as at Staunton, Va., the old-time council appoints a manager and puts him in charge of the city's work, mainly or entirely. In Staunton, for example, the police and fire departments are under the control of the mayor, tho the general manager does the purchasing for these departments, and directs the street, lighting, waterworks, park and poor administration.

IV. The "Commission-Manager" plan provides that the commissioners, elected under the commission form, appoint a general city manager to whom they turn over the city's affairs to manage. They retain the policy-deciding (legislative) function, and may retain also the more important *general direction authority* (administrative power in the broader sense—municipal affairs are largely matters of administration) turning over the executive work in its name immediate direction to the city manager. If the commission does not retain definitely the general administrative oversight of the manager, we have a reversion to the old doctrine of "separation of powers," powers which we have come to believe it is impossible and unwise to attempt to separate sharply, but which should both be exercised, to some extent, by the same body (as in the commission form), to insure successful city government. We have come to believe legislative power should be accompanied by at least general administrative oversight, tho the details of administration may well be intrusted to expert superintendents, familiar with waterworks, lighting and other fields of municipal business. Any attempt to deprive the city commission of general oversight of the executive departments must be regarded as a distinct step backward, and many advocates of the commission form have feared that this would result with the advent of the city manager.

The old aldermanic system, a fifth type with mayor, council and unrelated departments, is not given in this classification. It is advocated today by few advanced thinkers along municipal lines, tho a few still maintain that there is no necessary relation between forms of organization and efficiency. In the United States, the mayor and council plan is being deserted every week for the commission form or some other system of more advanced governmental organization.

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¶ THE *adoption of commission government by over 300 cities proves in a large measure the success of this method of control.*

About three hundred cities, as already shown, are under the commission form. The trend toward this is so marked as to be recognized even by its opponents as a coming type of city government. The "managing commission" has proved capable of a large degree of foresight in planning, of unity and promptness in action, and of real public spirit.

The "mayor-manager plan" has not yet met with great favor; there seems to be

an underlying North American prejudice against "one-man power." Dallas, Denison, Greenville, Texas, Lewiston, Idaho, and a half dozen other cities have given their mayor-commissioner large powers; and there are all gradations, from nearly the same authority and salary as the other commissioners, to both vote and veto, power to remove without the concurrence of the other commissioners, and a salary nearly twice that of his colleagues, as in Houston.

The commission-manager plan has been adopted in Sumter, S. C., Hickory and Morgantown, N. C., and more recently in Dayton, Springfield and Columbus, O. With the adoption of this method of government, cities of the population of Dayton will enable us soon to judge of its probable merits for other cities of like size.

卐

¶ SINGLE-HEADED *versus many-headed government, with the commission-manager plan as a fusion of the best in each method.*

The long-standing dispute between those who favor the single head in government and the advocates of the group or executive board crops out again in the discussion of the commission form. "Nothing like a single head for efficiency," cry the former; "too many cooks spoil the broth"; while the latter point out the value of several minds in conference, and decry "one-man" power. "For determining policies," say the proponents of the group type, "a commission is far better than a single person: in many counselors there is safety," while they call attention to the fact that each department has a single head, and unity of administrative direction results, at least, in each department.

To one viewing the case as involving the fundamental excellencies and defects of each sort of organization—the single-headed versus the many-headed—it appears that each side is partly right. The group or commission, while strong in planning the city's work and in executing the work of individual departments, may fail to co-ordinate fully the execution of all the divisions, unless the mayor or some other commissioner is given the co-ordinating power; while the single legislator-executive is likely to lack the broad outlook of the many, and to over-emphasize certain favorite phases of civic activity. The commission-manager plan is an attempt to combine the advantages of both methods, and to substitute a single executive for the executive board usual in the commission form. Let us examine its tendencies more in detail.

The commission-manager plan is undoubtedly preferable to the council-manager plan. Assuming that the commission appoints the executive, is there likely to be greater harmony in choosing a single general administration expert, who must please all the members of the commission, than in picking five assistants, one expert in each department, as are the waterworks or lighting superintendents or the director of parks? Must not the general manager have five assistants, or at least several? Is there not merely added one more step between the commission and the departments?

Further, is not the manager likely to over-emphasize some one side of matters municipal to the exclusion of other phases? He may handle the city's finances well, but fail to enforce laws or to look after the city's health. The manager whose training has been that of civil engineer would tend to see the engineer's problem, the banker who might be chosen would regard a balance on the right side of the ledger as most important; the former police chief would value highly an efficient service of public safety. Unusual breadth and business training are needed for an all-around good city manager—capacity to see all the needs of the city in reasonably correct proportions and meet them by appropriate action. At the present stage, have we such men generally available? And are we not already developing the right sort of municipal expert under our commission governments? Why not develop the mayor under the commission form into a general manager, in effect tho without the title, and retaining the commission form? Why not, if necessary in the interest of unity of administration, make the mayor clearly

the strongest position in the commission; to give him greater supervisory power; to increase his salary; to require previous municipal or other administrative service, tho it will be doubtful if it will be wise to restore his veto.

Finally, is not the manager likely to acquire such larger powers (as executives have frequently opportunity to do) as to overshadow the commission and ultimately to dominate it? Will not citizens come to vote for a commissioner because he is known to favor so-and-so for manager, rather than for the reason that he would help plan wisely for the city, in which case the commission would become in time a fifth wheel—an unnecessary part of the machinery of government?

The city manager plan has a business-like sound, and appeals to many on that account, and when tried should be judged on its merits. But let us adapt and use the type of city government which has already met with such marked success and proved its substantial worth—the commission form.

The commission form offers to the governing body the greatest opportunity for efficient team work. If there be lack of harmony, let citizens inquire into it. Let city clubs and chambers of commerce and civic leagues see that commissioners are elected who will co-operate and call attention to any lack of co-operation. If necessary as a last resort, give the mayor more power. But the board—the group—the commission—offers a flexible governing body of the greatest possibilities. The burden of the city's work may be divided, shared, shifted to the shoulders of the man fitted for it, equalized. Unity should be of the high type present when strong men work together toward a common end. The members of the board should work out a broad and comprehensive policy for their city, and supervise in a strong and reasonably harmonious way the carrying out of all necessary measures. The commissioners will thus become in time real municipal experts. The mayor will tend to become a general managing expert; the commissioner of public safety, a master of police and fire matters; the commissioner of streets and public works, a master municipal engineer. The profession of city administration is in our midst. Young men may well prepare for it. And as they prepare for it, let them study not only correct forms of organization, but what to do with the organization after the correct form is adopted.

LIST OF BEST BOOKS ON COMMISSION GOVERNMENT.

Beard—Digest of Short Ballot Charters. Short Ballot Organization, 383 Fourth avenue, New York. $5.00.

Bradford—Commission Government in American Cities. The Macmillan Co., New York. $1.25.

Bruere—The New City Government. Appleton, New York.

Childs—Short Ballot Principles, $1.00. 383 Fourth avenue, New York.

Hamilton—Government by Commission, or the Dethronement of the City Boss. $1.20. Funk & Wagnalls Co., New York.

MacGregor—City Government by Commission. $1.00. Extension Division, University of Wisconsin, Madison, Wis.

Woodruff—City Government by Commission. $1.50. National Municipal League, Philadelphia.

There are many other books and pamphlets given in the list published by the Library of Congress.

THE MUNICIPAL *Board of Directors.*

THE CHEVY CHASE EXPERIMENTAL ROAD

THE experimental road thru Chevy Chase, Md., starts from the line of the District of Columbia and runs north on the extension of Connecticut avenue, Washington, past the Chevy Chase Country Club to the loop of the Capital Traction Co., at Chevy Chase Lake.

The various sections of it were laid, using various emthods of construction, at various times during 1911, 1912 and 1913.

The work of 1911 consisted of a series of comparative tests of bituminous binders now on the market, and included seven sections on one or both sides of the street railway tracks on Connecticut Ave., and four sections on Bradley Lane, a narrow road running west from Connecticut Ave. The Connecticut Ave. sections were laid between Oct. 15 and Dec. 5, 1911. An inspection in October, 1913, showed the following conditions, a brief statement of the construction preceding the stateemnt in each case:

Sec. 1. Three inches of 1 to 3-in. stone with 1.8 gal. heavy tarvia per sq. yd., screenings rolled in, 0.8 gal. tarvia added and additional screenings rolled in. Bitumen well worn off, but surface smooth and well compacted.

Sec. 2. Same construction with 1-in. sand cushion treated with 1.18 gal. tarvia under the stone and 1.95 gal. heavy tarvia in stone and 1.02 gal. in surface coat. This section bled excessively in 1912 and was treated with stone chips several times to take up excess of tar. Three to five feet in width next the car track has worn thru the bituminous coat, and 3 to 9 feet width next the gutter is wavy and rough. The remainder of the width is in good condition.

Sec. 3. Three inches of 1 to 2-in. stone rolled and poured with 1.46 gal. Bermudez road asphalt, and 0.5 gal. in surface coat. Condition similar to Sec. 1, but

THE *completed Chevy Chase sample of brick road.*

areas near gutter and in north 100 ft. surface somewhat more wavy.

Sec. 4. Same construction as Sec. 3, except that 1.65 gal. of Gilsonite oil-asphalt was used in stone and 0.55 in surface coat. About the same condition as Sec. 2, but less worn along street car track and with several large raveled

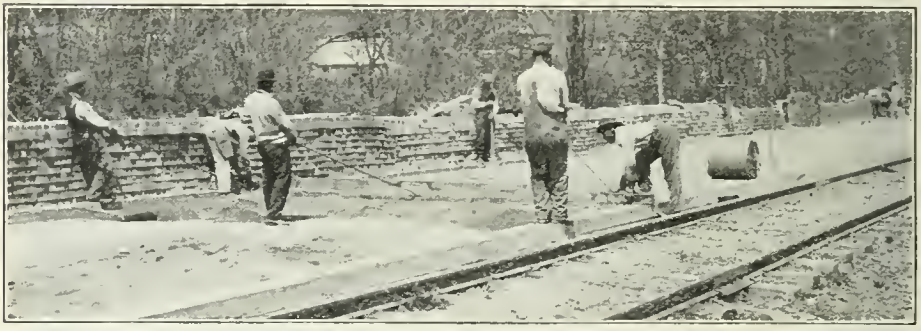
Sec. 5. Same construction as Sec. 3, except 1.69 gal. of Standard Oil macadam

binder was used in stone and 0.56 gal. in surface coat. Same condition as Sec. 2, but less worn near track and gutters and two raveled areas.

Sec. 6. Thickness 3½ in. of 1 to 3-in. stone, with 1.56 gal. Texaco oil-asphalt in stone and 0.53 gal. of harder grade of same in surface coat. Condition similar to that of Sec. 3.

Sec. 7a. Thickness 3½ inches of 1 to 2½-in. stone with 1.66 gal. of asphaltoilene in stone and 0.6 gal. in surface coat.

Sec. 7b. Same except that chips were rolled into the dry stone, 1.86 gal. of asphaltoilene aplied and chips rolled into surface. Condition about the same as Sec. 3. The single coat section, 7b, is the better and is in good condition, fully equal to Sec. 3.



PREPARING *sand cushion for Chevy Chase sample brick road.*

In 1912 Section 8 was laid in August, 9 in June, 10 in November, and 11 in December. These sections were reported in February, 1913, as requiring a treatment in 1913, and probably received it.

Sec. 8. Cold ugite, refined water-gas tar, was applied to the surface of a water-bound macadam road; 0.54 gal. first then limestone chips after 3 hours. In October, 1913, none of this material was visible.

Sec. 9. Trinidad asphaltic oil applied cold, as in sec. 8, 0.53 gal. per sq. yd. Condition nearly equal to sec. 3.

Sec. 10. Indian Refining Company, residual petroleum applied hot under 60 pounds pressure after dust had been swept off of macadam road. Apparently in about same condition in October, 1913, as No. 3, except much more wavy in the half of the width next the gutter, where the automobile travel is least heavy.

Sec. 11. Westrumite emulsion of asphalt mixed with stone, laid 2½ inches thick and rolled. Has a good surface, showing a few stones, harder and smoother than the sections laid in 1911.

The preceding sections run up the west side of Connecticut avenue from the district line to Bradley lane and down on the east side. The following sections run north from Bradley lane on the west side of the street railway tracks.

The first experiment is with a bituminous concrete laid according to the Topeka specifications between September 9 and December 13, 1912. The cost was $1.8662 a square yard. In October, 1913, this section was in excellent condition, equal to a new asphalt pavement.

The second experiment is similar, laid under the District of Columbia specifications, and is in equally good condition. It cost $1.9565 a square yard.

Experiment 3 is of cement concrete, the surface coated with bituminous materials. In the middle half limestone was used for concrete, at the two ends gravel was used. The surface of the concrete was floated and joints between days' works made at an angle of 80 deg. with the curb. It was covered with sand while setting, which was removed and the bituminous coat put on early in 1913. The gravel concrete cost $1.3985 and the limestone concrete section $1.4285 per sq. yd. The concrete was in excellent condition in October, 1913, except that 10 or 12 spots of 2 to 20 sq. ft. each near the gutter have disintegrated. Some 50 spots near the

south end show use of bitumen to fill pits in the concrete. There are several transverse cracks 30 or 40 feet apart near the south end and several quite close together farther north.

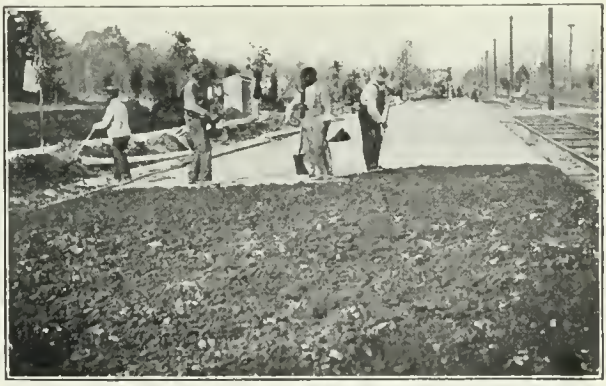
There are three rows of brick across the road between experiments 2 and 3 which project objectionably and indicate wear or flow of the bituminous material away from the joint.

Experiment 4 is with oil-cement concrete, 5 pints of a fluid residual petroleum being used to a bag of cement in making the concrete. These sections were in fine condition, especially the trap rock section. There are 18 or 20 transverse cracks, about half of them repaired by filling with tar. Most of the cracks are in the gravel section, where they are 40 to 60 feet apart. Gravel, limestone and trap rock, plain and oil concrete sections are alternated so as to make the results as fair as possible to all materials. Part of these sections were laid late in 1912 and part early in 1913. The section at the north end has no oil in the concrete and has 7 per cent. of hydrated lime in the cement. It has 3 cracks. Trap rock plain concrete cost $1.4464 a square yard. Oil cement concrete cost $1.4766 for gravel aggregate, $1.5066 for limestone and $1.5245 for trap rock.

The vitrified brick section was laid April 29 to May 7, 1913, under the supervision of W. P. Blair, the secretary of the National Paving Brick Manufacturers' Association. Fourteen kinds of brick were used, with rattler losses ranging from 16.36 to 38.89 per cent., and the entire surface

LAYING *brick on Chevy Chase sample road. The two-inch sand cushion is shown in front and the roller is following closely behind the brick-laying gang.*

LAYING *concrete direct from mixer and floating surface of Chevy Chase sample concrete road. The large portable mixer discharges the concrete exactly where it is wanted.*



COVERING *Chevy Chase sample concrete road with earth to season. This earth covering was left on all winter and the bituminous surface was put on in the spring.*

GROUTING *the Chevy Chase Sample brick road. Laying and rolling brick in background.*

is in the best of condition at this time, as shown in the photograph. The cost of the brick pavement averaged $2.5821 a square yard. The detail of the cost is given as follows in cents per square yard:

Base—		
Gravel	27.30	
Sand	9.30	
Cement	23.40	
Mixing and placing	17.45	
		77.45
Pavement—		
Sand in cushion	10.10	
Preparing cushion	3.66	
Brick	80.00	
Unloading and piling from car	15.23	
Hauling and piling by road	11.18	
Laying	5.20	
Rolling brick	1.76	
Sand in grout	0.80	
Cement in grout	5.08	
Grouting	2.96	
Protection	1.57	
		137.54
General—		
Preparing subgrade	21.44	
Superintendent	10.43	
General expense	4.54	
Miscellaneous	6.81	
		43.22
Total		258.21

The 6 by 8-inch concrete marginal curb cost 10.12 cents a linear foot. The expansion joints cost 3.84 cents per linear foot.

The expansion joints along the marginal curb for the first 200 feet at the south end were filled with a mixture of 1 part coal tar pitch and 1 part Portland cement; for the next 200 feet they were filled with asphalt felt; and for the remaining distance with an oil asphalt.

There were large differences in the quality of the fourteen kinds of brick used in laying the pavement, as may be seen from an examination of the surface and still more clearly from the following results of some of the tests made of the bricks as laid, the results being arranged in the same order as the bricks in the street, beginning at the south end. Lots B and N are wire-cut lug blocks, the latter of fire clay. The others are repressed blocks:

Brick.	Modulus of rupture.	Absorption, per cent.	Rattler loss, per cent.	Sand blast loss grams.
A	1728	1.39	21.13	27.0
B	2498	1.31	16.36	23.3
C	2423	0.88	25.57	27.1
D	10.52	1.65	17.67	32.1
E	3240	1.10	22.04	20.6
F	1730	1.81	18.80	41.5
G	1615	2.29	27.92	35.1
H	....	3.74	22.68	35.8
I	1890	2.86	22.59	42.5
J	1825	1.56	19.11	37.1
K	1750	2.38	37.68	50.5
L	1765	4.04	38.89	84.5
M	2113	3.75	24.31	44.0
N	2100	3.68	31.19	28.5

The last column gives the results of test of ability of resistance to the action of the sand blast, a new test, whose value has not yet been demonstrated. Comparison of the figures in the last two columns will be of interest and does not show much similarity. The wear in the road will doubtless throw some light on the relative value of the rattler and the sand blast tests of abrasion.

WATER SUPPLY OF LOUISVILLE, KY.

This Brief History of the Louisville Water Supply Shows the Improvements in Methods of Purification of Water in the Past Thirty Years.

THE water works of the city of Louisville, Ky., are typical of many supplies from surface sources thruout the country and their growth is along lines paralleled and to be paralleled by many others.

The city is level, except for a thinly settled residence and park district on the east, on one of the hills of which the main reservoir of the water works is located. The pumping plants are on the river bank from which the supply is taken and at the reservoir from which the filtered water is pumped to the distribution system.

The original plant was constructed in 1857 to 1860 by the Louisville Water Company, the stock in which was owned in part by the city and in part by private persons. The city later purchased all the stock of the company and acquired full ownership in 1906, and the works are now operated by the board of water works, five members, of which Charles F. Grainger is president. Charles Hermany, past president of the American Society of Civil Engineers, was superintendent and engineer for the whole period of existence of the works until about the time of his death

COAGULATING *basin and Crescent Hill reservoir of Louisville water works.*

in 1908. The present superintendent, Theodore A. Leisen, was appointed in 1908.

The city now has a population estimated at 230,000, the census of 1910 showing 223,928. The old pumping station contains two Cornish pumping engines, built in 1860, with a capacity of 6,000,000 gallons each per day, and formerly had two Blake pumps, built in 1879, each of 3,000,000 gallons capacity. The Cornish engines are held in reserve and are always ready for use.

gallons a day. Boiler insufficiency and other complications have delayed the full use of this pump and its efficiency could not be tested during the year of the last report, 1912. With a maximum pumpage of nearly 40,000,000 gallons a day and an average of about 25,000,000 gallons any two of the pumps in the new station can meet the demands and for much of the time either of the newer pumps can take care of them. The river stations pump to the Crescent Hill reservoir, first built in 1877-9, under a head of 190 feet.

RESERVOIR *for filtered water as it appeared under construction. Forms for roof arches in place at the right.*

The architectural character of the building and the standpipe adjoining it are quite remarkable. The flood of April 2, 1913, did not quite reach the level of the entrance to the building.

The new pumping station at the river has a pumping engine designed by Mr. Hermany and E. D. Leavitt in 1893, of 18,000,000 gallons capacity, and an Allis-Chalmers pump built in 1908 of 24,000,000 gallons capacity. A new Worthington centrifugal pump was installed in 1912 increasing the pumping capacity 30,000,000

The water from the reservoir flows by gravity thru the filter plant to the Crescent Hill pumping station, where there are three Holly pumps, each of 24,000,000 gallons capacity, two installed in 1906 and one in 1908, so that this station is on a par with the new river station. These pumps deliver directly into the distribution system under an average head of about 110 feet.

The cost of pumping at the river station in 1912 was $2.36 per million gallons or $1.39 per million gallons raised 100 feet dynamic head. At the Crescent Hill station it was $2.55 per million gallons, of $2.32 per million gallons for 100 feet dynamic head.

The water is taken from the river thru an inlet tower, and there are two 36-inch and two 30-inch mains from the pumps to the reservoir, about 8,000 feet distant.

The Crescent Hill reservoir, which serves also as a settling basin, has two sections of about 50,000,000 gallons capacity each, to permit cleaning without interfering with the supply of water. The reservoir was repaired, cleaned and lined with concrete in 1910 at an expense of about $100,000. The cost of cleaning out the accumulations of fifteen years was about $50,000. A coagulating basin to aid in the treatment of the Ohio river water, which is highly charged with sediment, was put in use in part in 1910 and completed early in 1911. It has aided materially in reducing the cost of cleaning filters.

The plant for treatment of the water was designed by Charles Hermany after an extended series of experiments made by George W. Fuller in 1895-7 to determine the method best suited to the condition of the Ohio river water. It includes the use of the Crescent Hill reservoir for sedimentation purposes, the two coagulation basins and the filters proper. The filters are of special design, the original plan showing six filter tanks each 30 by 146 feet and of 12,000,000 gallons capacity per 24 hours, three of which have been built. They are of the gravity mechanical type, and originally had a mechanical device for stirring the sand during the process of washing, which was movable from one bed to another. A coagulating standpipe was provided.

The operation of the filters not being satisfactory, Hering and Fuller advised in 1908 that the large filter basin be divided into two each, that the machine for stirring the sand be abandoned, the methods of straining and washing and providing wash water be improved and the coagulating basins of the original general plan be constructed.

The course of the water is now first to the sedimentation reservoirs, which are cleaned at more frequent intervals than formerly. Thence the water flows to the coagulation basins, where there is time for the coagulants to produce their effect, and opportunity for frequent washing out of the deposits thru a 24-inch pipe which will discharge this sludge into the river. Thence the water flows to filters which are shown in one of the illustrations.

When filtered the water is discharged into the clear water basin, which is located immediately under the filters. This basin is shown under construction in one of the accompanying photographs and an interior view is shown in another.

The full value of the purification plant was not obtained until the latter part of 1911 and the report for 1912 shows the results of the first full year of operation. The turbidity in 1912 was greater than usual and, computed from the average analysis, amounted to 9,800 tons or an average of 2,100 pounds for each million gallons of water filtered. This is over 26 tons of mud removed from the water per day. Of this the sedimentation reservoirs removed 49 per cent., the coagulating basins 45 per cent. and the filters the remaining 6 per cent., the efficiency being 100 per cent. At the same time the sedimentation basin removed 58 per cent. of the bacteria in the river water, the coagulation process removed 34 per cent. and the filters removed 7 per cent., the total bacterial efficiency of the system thus being over 99 per cent.

The typhoid fever death rate of the city follows this improvement, the rate of 18 per 100,000 population of 1912 being 18 per cent. less than the rate in 1911, with a total decrease of nearly 70 per cent. from the average of the four years preceding the installation of the filter.

The first of the illustrations shows a view of the sedimentatiou and coagulating basins, taken from the elevated tank which serves as a pressure regulator on the distribution system and is located near the Crescent Hill pumping station, filter house and clear water reservoir. The coagulating basins are in the foreground, the nearer one being about half the area of the one adjacent and with half the length of flow. Beyond is the Crescent Hill reservoir, the nearer division being full of water and the farther division being emptied for cleaning.

The cost of filtration for 1912 averaged

INTERIOR *view of the covered filtered water basins.*

$3.42 per million gallons. The monthly average cost varied from $2.59 in October to $5.03 in April. The coagulant used cost nearly half of the whole expense of filtration for the year, and in each of the first three months of the year reached nearly or quite 60 per cent. of the total expense for the month. The water used for washing the filters cost only about 1.2 per cent. of the total filtration expense. The wash water used averaged 2.37 per cent. of the amount filtered for the year. The filters are now operated almost up to their full capacity and plans are ready for the addition of twelve filter units, each 23 by 47 feet, which will double the size of the plant, filling the half of the building provided for this extension in the original plans. These filters will be gravity mechanical filters of the same type as those in use, but the units are more numerous and smaller in size so that a unit out of commission for cleaning will cut down the capacity only 3,000,000 gallons, thus giving a practically constant capacity of 33,000,000 gallons additional to the present rated maximum of 30,000,000 gallons capacity.

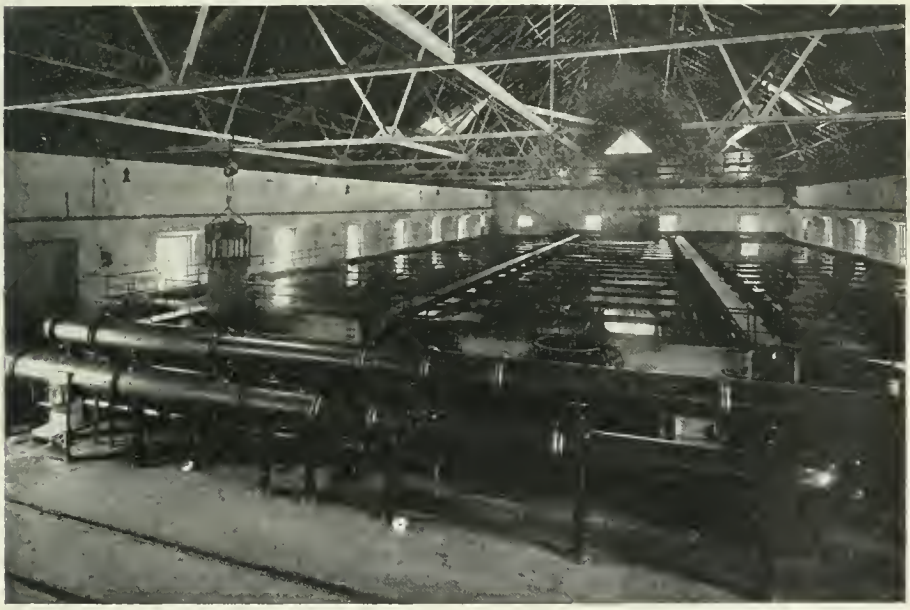
One of the most important recent improvements in the distribution system of the plant is the creation of the meter department in 1911. Water for manufacturing purposes has been metered for some years and in 1911 there were 2,800 meters in use, of which 2,099 were of one-inch size or less, and 35.6 per cent. of the consumption was metered, but the meter department is an evidence of the increased interest in the sale of water by equitable methods of measurement.

One of the indications of the need of a department devoted to the meter system is the increase in metered water due to testing of meters. The registration of water passing through meters was increased more than 40,000,000 gallons in 1912 on account of the displacement of incorrect meters after test. The increase in earnings is estimated at $32,000, due to this registration of water formerly passing by without notice. The total cost of exchanging the meters was less than $5,000. The total cost of the construction account of the meter department was about $26,000, and it cost nearly $10,000 to install new meters on new service, so that the increase in earnings is fully double the old meter construction account

and some $6,000 more than the total cost of the old department.

The activity of the department increased the percentage of water metered, including the above addition, from 35.6 per cent. in 1911 to 40.8 per cent. in 1912 and of the revenue from metered water from 44.1 per cent. of the total water revenue in 1911 to 44.3 per cent. in 1912. The increase in percentage of revenue is not so great as the increase in percentage of metered water, probably because a decrease made in rates affected the revenue from metered water more than that from unmetered water. This reduction in rates took the form of an increase in discounts for larger quantities of water used and for prompt payment, the discounts formerly being about 10 per cent. and now averaging some 25 per cent. The reduction in consumption due to complete metering of the consumption would postpone for a considerable time the necessity of increasing the size of the filter plant, which is imperative with the present maximum consumption. It would also make the construction of an additional pumping unit at the Crescent Hill station unnecessary for an indefinite period.

Acknowledgment is made of the courtesy of Theodore A. Leisen, superintendent of water works, in supplying information and illustrations.



INTERIOR *of the filter house showing piping in foreground; filter beds in the rear and cleaning apparatus between.*

NEW SEWAGE DISPOSAL PLANT *of* ATLANTA, GA.

The Second Plant for the Purification of the Sewage of Atlanta, Ga., just put in Operation, is Described—Especially as to the Roughing Filters, which are Peculiar to this Plant.

GENERAL *view of Peachtree Creek Sewage Disposal Plant, Atlanta, Ga. Imhoff tanks in foreground. Sprinkling filters in rear at left of center. Grit chamber and sludge beds at extreme right in background. Towers indicate location of groups of roughing filters.*

THE second unit of the sewage disposal plants of Atlanta, Ga., serving the Peachtree creek watershed, was completed and put in operation on September 8. It has not been in continuous operation since that time on account of some construction on the main sewers leading to it, and the results of operation are not yet complete enough to give much indication of the success of the plant, altho general observation of the plant shows that it is doing excellent work.

Dr. Karl Imhoff, the inventor of the system of purification used in the plant, visited it on October 4 and was well pleased with this, the largest plant on his system which has been constructed. It happened not to be in operation on that date, but the Proctor creek plant was in full operation, producing the best effluent which he had observed.

The layout of the plant is indicated in the general photograph of the plant herewith. The grit chamber, where the sand, which is so prominent a feature of Atlanta drainage, is removed, is in the background at the rear and to the right of the cement walk on which the men are standing. The sewage flows thence in a 42-inch pipe parallel to the walk and is let into the three divisions of the settling tanks near their centers, the division in the foreground being but half completed, so that the sewage is let into it at the left end. Between the groups of settling tanks are located the roughing filters, extending across the array of tanks and having the gate and pump houses seen in the photograph at one end. The water flows from the tanks thru these roughing filters and thence thru a 48-inch pipe from the left of the two gatehouses to the dosing tanks, which are in the middle ground at the extreme left of the picture and are too low and flat to be seen. The sewage is discharged intermittently by the dosing tanks on the various divisions of the sprinkling filters, the location of which, in the middle ground to the left of the left gate house and behind it, is indicated by the ventilators which project above its surface. The sludge drying bed is located at the extreme right in the background and to the right of the grit chamber. Peachtree creek flows along the sludge bed and the filter beds on the farther side of both, from right to left

W. A. Hansell, Jr.,
Asst. Supt. of Constr.

Dr. Karl Imhoff.
Inventor of settling tanks.

R. M. Clayton,
Supt. of Construction.

THE ENGINEERS *responsible for the Atlanta Sewage Disposal Plant.*

across the picture, and receives the purified effluent.

The preliminary screen, the grit chambers and the settling tanks are similar in design to those in use at the Proctor creek plant, which was described in MUNICIPAL ENGINEERING, vol. xlv, p. 224, but provide for the purification of the sewage from about three times as many people.

One of the photographs shows the grit chambers, which are three in number, each 5 feet wide, 38½ feet long, 5½ feet deep at one end and about 8½ feet deep at the other. All three of the grit chambers are shut off by stop planks in the photograph and the sewage is flowing around them thru a channel four feet wide. The screen and the inlet to the grit chambers is in the background and the effluent flows into the 42-in. conduit to the filter beds at the right foreground. The easy curves for the flow of the sewage to and away from the grit chambers should be noted as a point of excellence in the design.

The point of difference from the Proctor creek plant is in the substitution of roughing filters for the revolving screen between the settling tanks and the dosing chambers of the filter beds.

There are 30 Imhoff tanks in three groups. Each of the first two groups has 12 units, and between them is located one of the groups of roughing filters. Between the second group and the third, of 6 units, is located another group of roughing filters. Each group has 20 filter units, each 9 ft. 2 in. square.

From 2 in. to 1 ft. depth of sewage may be carried on the top of the 12-in. depth of broken stone thru which the liquid filters. This stone is supported on cast iron plates perforated with 9/16-inch square holes, supported on ledges in the concrete walls and two reinforced concrete beams across the filter squares. The sewage passing thru the broken stone filters, collects in a sump at the base of the pyramidal bottom and runs thru an 8-inch pipe to the 42-inch main drain and thence to the dosing tanks for the sprinkling filters. The rate of filtration thru the roughing filters may be as much as 175,000,000 gal. per acre per day and by stop planks the number of filter units necessary to keep the rate down to or below this can be thrown into operation.

A promising method of cleaning the filter units has been devised. In the basements of the little towers seen in the photograph of tanks and roughing filters are 6-inch electrically driven centrifugal pumps, which draw their supply from the drain which carries the effluent from the settling tanks and roughing filters to the dosing tank of the sprinkling filters. This connects by a 6-inch force main with each of the 8-inch outlet pipes of the roughing filter units. When a unit is to be cleaned

ROUGHING *filters to remove solids from Imhoff tank effluent, Atlanta, Ga., Sewage Disposal Plant. Imhoff tank in left foreground. Roughing filters with gate and pumphouse next in rear. Then more Imhoff tanks, more roughing filters, and again more Imhoff tanks. Sprinkling filter bed in background.*

the influent from the settling tanks is shut off by stop planks, a valve is closed, shutting off the connection with the 42-inch main drain, a valve in the 6-inch force main is opened and the water is forced by the pump back thru the filter stone from below and runs off thru an outlet channel at a level high enough to discharge into the settling tanks. One or more of the roughing filter units may be cleaned at a time.

In the photograph a settling tank is seen in the left foreground. Beyond are two rows of the roughing filters, with inlet channel between, and the pump and gatehouse at the left end; still farther beyond are four rows of settling tank units; another double row of roughing filters, with its pump and gatehouse and four more rows of settling tank units. In the background is a view of a small portion of the sprinkling filter area.

The portrait cut shows Dr. Imhoff in the center, R. M. Clayton, the superintendent of construction of Atlanta, on his left and W. A. Hansell, Jr., the assistant engineer, who is in charge of the design and construction of sewers and sewage disposal plants, on his right.

GRIT CHAMBER, *Peachtree Creek Sewage Disposal Plant, Atlanta, Ga.*

STREET LIGHTING WITH TUNGSTEN LAMPS

This condensation of a paper, for which we are indebted to the editor of the General Electric Review, states the six necessaries of good lighting effects and methods of obtaining them under the marvelously improved modern conditions in the electric lighting field.

UNTIL recently the success of a street lighting system was too often judged only by the brightness of the individual units, but now, thanks to the better general knowledge of the subject, the merits of a lighting system are determined by the amount of light rather than by the brightness, and also by the proper distribution. Indeed, the art of illumination has made such rapid progress that today, in up-to-date communities, a good lighting system is considered as essential as is a good police system and an efficient fire fighting force.

The economic and scientific aspects of the problem are daily receiving more attention. These may be summarized as follows:

(1) A sufficient amount of light must be supplied and so distributed as to give an approximately uniform illumination.

(2) Street lamps should have as low an intrinsic brilliancy as is compatible with economy, and be so located that any glare will not interfere with ordinary vision.

(3) With the usual height and spacing, the greatest intensity of light should leave the lamp at an angle of about 20 degrees below the horizontal.

(4) The light should be steady, for flickering obviously reduces the illuminating efficiency of the lamps.

(5) There should be good diffusion of the light rays so as to avoid deep shadows.

Taking up these important considerations more in detail:

(1) The actual intensity of light required for safe traveling varies with the amount of traffic on the street. If the traffic is heavy and liable to become congested, a large amount of light should be supplied so that all obstructions can be perceived at a glance. To escape being run over or to avoid collisions, quick decision is often necessary, and accordingly there should be sufficient light on the street so that the easiest and safest path can be instantly detected. In other places, where travel is not as dense, the danger of collision is reduced and less light will be found satisfactory.

Uniform illumination, however, is a quality which every street lighting installation should possess, and to which too much importance cannot be attached. This does not mean that there should be absolutely no variation in intensity over the entire street surface, but rather that there should not be a great variation between the maximum intensity near the lamps and the minimum intensity midway between. The allowable variation has been given as 10 to 1, and although this value cannot always be attained in practice, yet it can often be closely approximated. In fact, the gloom in the dark portions of the street is apparently very much deepened by contrast with the adjacent light portions, and consequently greater caution should be exercised. Some writers have recommended a non-uniform illumination as assisting in so-called silhouette vision. It is probable that this does present some advantages to the automobilist, whose headlight eliminates the dark spaces, thus decreasing the contrast

effect. The automobilist, being interested in seeing a considerable distance ahead, would see large objects silhouetted against the background. On the other hand, the ordinary driver and particularly the pedestrian, who really deserve the first consideration in designing street lighting, are considerably handicapped by the uneven illumination, since they cannot readily see inequalities or obstructions in the pavement, if such happen to come in a dark part. Better effect can be obtained, even with a lower total flux of light, by spacing smaller units closer together. In other words, the actual intensity of light need not be high if the distribution is uniform.

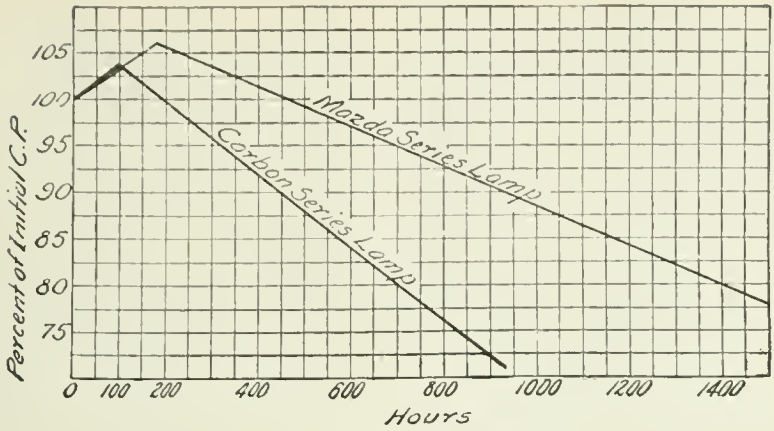
(2) Glare is always objectionable and to minimize it the light rays must be prevented from entering the eye directly, or an illuminant of a relatively low intrinsic brilliancy must be chosen. The lamps along the side of the streets should be as high as practicable, so as to keep them out of the range of vision when looking up or down the street.

(3) If the maximum candle-power were nearer the horizontal, too much of the light would be wasted on the sides of the buildings or trees, while if the maximum candle-power were nearer the vertical, too great an intensity of light would be concentrated under the lamp.

(4) Not only is an unsteady light a source of discomfort to the eyes, but it interferes with vision to a degree depending upon the amount and character of the variation.

(5) By good diffusion is meant that the light rays radiated from the lamp should be so reflected and broken up that the apparent source of light is much enlarged. This does not allow a large amount of light to be concentrated in any one ray as it leaves the lamp, but instead increases the number of rays and decreases the quantity of light per ray, thus avoiding the possibility of deep shadows and at the same time reducing the glare. The deep shadows resulting from poorly diffused artificial light have the same effect as a flickering light source upon the eye of the observer who is rapidly pass-

WATER STREET, *Elmira, N. Y. Note well distributed illumination. No deep shadows. Posts* 60 *feet apart, three* 80 *c.p. lights on each.*



COMPARISON *of variation of candle-power during life of tungsten series and carbon series.*

ing thru alternate light and dark spots. spots.

(6) One of the most prevalent faults in present street lighting practice is the placing of lamps too near the ground. When the lamp is placed low, any little projection above the street surface casts a long shadow, and the shadows from larger objects are narrow and distorted. Consequently, the amount of street surface darkened by the shadows is much more than it would be if the lighting units were suspended higher. More powerful units only intensify the shadows and exaggerate the trouble. Reasonably high suspension of the lighting unit aids in furnishing the proper amount of light to the points midway between the lamps, and reduces the glare from contrast between the light and dark spots. There is, however, the other extreme, which should also be avoided, that is, the excessively high suspension of the lamps. Sometimes the foliage interferes with the distribution of the light so as to prevent the proper theoretical suspension of the lamp. But the general rule holds that we should suspend the lamps fairly well above the ground in order to illuminate distant points properly and make the shadows as short as possible.

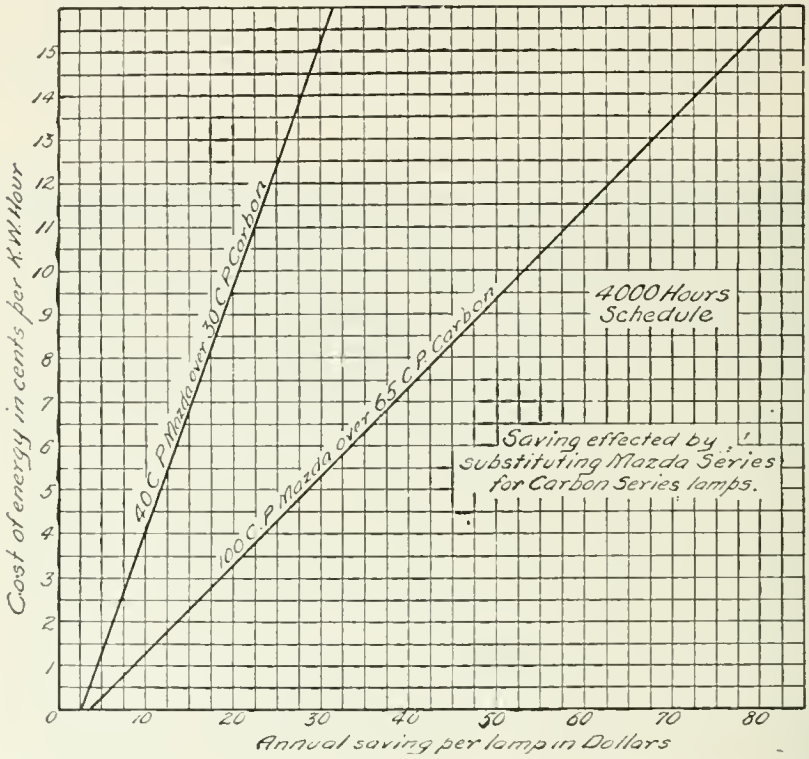
If there is an installation giving a certain minimum normal intensity at the midway points, and it is desirable to double the distance between the lamps without altering the minimum intensity, then, if the height of the lamps is also doubled, the light flux per unit must be four times as great as before, because the intensity from a given light source varies inversely as the square of the distance. Conversely, for the same illumination and twice as frequent spacing, the light flux per unit will be only one-fourth as great, with a corresponding decrease in the amount of energy consumed. It will therefore be seen that on the basis of light flux and energy alone, smaller lamps and closer spacing would be best. But with every lamp unit there is a certain fixed charge independent of the energy consumed. If the lamps are spaced too close together this fixed charge per unit becomes larger than the energy charge per unit. There is accordingly a midway point which gives the best lighting effect and is at the same time most economical. The series tungsten system with its low maintenance charge per unit and the great range of sizes in which it is made, allowing the selection of that size of unit which will give the exact amount of light desired at any point, closely approaches ideal conditions.

Tungsten filament lamps will operate equally well on either direct or alternating current of any commercial frequency, thus allowing the selection of that kind of energy which can be most economically generated and transmitted under local conditions, or the connection of the lamps to some circuit already installed. Furthermore, when a constant current trans-

former is employed it allows the use of different sized units, either temporarily or permanently, without the cost of a new circuit. The new lamps are selected for the required candle-power, but of the same ampere rating as the circuit already in use, and installed at the desired points upon the existing circuit.

Tungsten lamps can be operated with complete satisfaction in series with magnetic arcs, provided precautions are taken to avoid an excessive starting current. Care should be exercised, however, to select lamps whose normal ampere rating is equal to that of the average current flow of the circuit. When a large number of tungsten lamps are located in reasonably compact groups, it may be advantageous to operate them on circuits separate from the arc lamps.

The series tungsten lamps for street lighting are rated in candle-power and amperes, and designed for a constant-current circuit. The same amount of current flows thru all the lamps upon the circuit. Lamps of different candle-power values, but of the same current strength, can be operated upon the same circuit. The candle-power rating is given because most street lighting contracts are made upon a candle-power basis. Such a contract basis gives the central station the benefit of any improvement or increase in efficiency whereby the same amount of light is secured for a smaller energy consumption.



SAVING *effected by substituting tungsten series for carbon series lamps, one line showing saving for 40 c.p. and one for 100 c.p. Mazda lamps.*

The series lamps are now made in both large and small sizes, and enable the lighting of entire cities being accomplished by means of tungsten filament lamps.

In downtown districts the use of the multiple lamp may be advantageous, since it can be tapped directly from the commercial circuits, thus simplifying the arrangement of wires either overhead or in conduit. In such cases, provision must be made locally for switching the lamps on

and off, either automatically or by patrolmen. Where a considerable number of lamps are to be controlled, it is the common practice to make the connection from a single switch for an entire block or square.

For long stretches of country roads or interurban thorofares, where the lighting need only serve the purpose of outlining the road, and where uniform illumination cannot be afforded, the series tungsten lamp is the best illuminant. It operates successfully on a high voltage alternating current circuit, thus securing the greatest efficiency of transformation and distribution of energy with the least cost in apparatus and equipment.

In some places where the foliage of the shade trees is allowed to come within 12 feet of the ground, the theoretically correct suspension of the unit would not be advantageous. Instead, the lamp should be placed so low as to be under the foliage, thus preventing any of the light from being cut off b ythe trees. In this way the amximum amount of light is given upon the roadway, and the best possible illumination secured, even tho it may not be ideally distributed. For every illuminant there is a certain spacing and height at which it will give the best results. Tungsten filament lamps of from 32 to 100 candle-power, equipped light from being cut off by the trees. In this way the maximum amount of light with radial wave reflectors, should ordinarily be placed at a height of 12 to 18 feet, and larger candle-power tungsten lamps with the same equipment at a height of about 20 feet, while the distance between lamps should vary between five and ten times the mounting height.

For instance, upon a business street, where the traffic is heavy and liable to become congested, an installation of 200 candle-power lamps, 18 feet high and 100 feet apart, on each side of the street; or, 350 candle-power lamps, 29 feet high and similarly spaced, would be good practice. The actual size of the lamps used would depend upon the intensity desired. Upon a residential street where the traffic is not very heavy sufficient illumination of a fairly even intensity would be supplied by 100 candle-power lamps placed 15 feet high and 100 feet apart. If the foliage were dense and close to the ground 60 candle-power lamps could be used, spaced every 60 feet and placed at a height of about 12 feet, which will ordinarily clear the foliage. Upon streets where the traffic is not sufficient to warrant even an approximately uniform intensity, and where the spacing of the lamps depends upon the money available for the lighting, the best results are obtained by using 32 or 40 candle-power lamps placed 15 feet above the ground.

Since the danger of collision is always greater at street intersections where lines of travel intersect, it is important that the lights be so arranged as to provide relatively high intensity at these points. This, however, does not necessarily mean placing the lamps at the extreme corner of the curb, since this might introduce glare which would interfere with the vision of a driver about to turn the corner, especially if the lamps are placed low.

Each lamp should be equipped with a radial wave reflector, which changes the distribution curve of the tungsten lamp so that the maximum amount of light is given off at an angle of 20 degrees below the horizontal instead of exactly at the horizontal. As a result, the actual illuminating efficiency of the lamp is increased 35 per cent. and uniform illumination is more easily obtained.

Placing consecutive lamps on opposite sides of the street is an aid in giving uniform illumination where the street is broad. Where the street is narrow staggering may not be as desirable as placing the lamps in a single row on one side of the street. In fact, it is more expensive to install, and is actually disadvantageous, as it confuses the outline of the road, especially where there are curves.

When a new series street lighting installation is being made, the current strengths that are most generally adopted are 4, 5.5 or 6.6 amperes. For any given candle-power the higher the amperage of the lamps, the lower their voltage. Therefore, for an installation of a definite number of lamps, of a definite candle-power, any decrease in the line current means a large increase in the line voltage, equal to the product of the increased voltage per lamp, multiplied by the number of lamps in the circuit.

REFUSE DISPOSAL METHODS AS ADAPTED TO CHICAGO

A Chicago Engineer Gives His Arguments for the Adoption of Incineration of Chicago's Garbage and Refuse, Based on Economy and Sanitary Features of Collection and Disposal.

The present unfortunate garbage situation in Chicago has been commented on all over the country. The citizens are naturally aroused and the city officials have been experiencing a most uncomfortable autumn. It is not the purpose of this article either to comment on the cause of the present condition or to criticise the methods suggested to relieve the situation temporarily, but rather to discuss the best method of procedure to obtain the most satisfactory system which would insure an economical as well as a sanitary disposition of the garbage of Chicago.

It has been the custom for the larger cities of the United States to dispose of their garbage by private contract instead of by municipally owned plants. All cities in Europe and in the English possessions, however, own and operate their disposal plants. Efficient service is manifestly the primal object of such a plant. Maximum efficiency under certain circumstances demands expenditures which would interfere with the profit of a private contractor and the service suffers.

Under American politics municipal ownership generally is more costly than private control uuder similar conditions. Contracts for refuse disposal, however, are only let for short terms and the contractor must therefore include the amortization of his entire equipment in the price bid and this has made the cost of private service greater than conservative estimates indicate for public operation. If long term contracts were legal the cost of refuse disposal might be less under private control. But the function of a disposal plant is to serve the community as a whole and if the best service is more expensive the excess is proportionately distributed by taxation.

Private control of the police or fire departments has never been seriously considered. Municipal water works, street cleaning and refuse collection, sewerage and sewage disposal, are the rule, with rapidly decreasing number of exceptious. The garbage disposal plant belongs to the same class. The case is different from public control of railroads or other transportation companies, telephone and telegraph corporations, or lighting and power companies. Efficiency or economy in the latter only affect that part of the community which uses them, while the former reach every individual in every walk of life. The marked difference in the functions of the two classes of service is that one affects public comfort and convenience while the other controls public safety and health. Expenditures governing these latter should be influenced only by the best service obtainable and the profit of any individual should be eliminated.

An important objection to municipal owuership of a refuse disposal plant has been the difficulty of obtaining a favorable vote from the taxpayers to authorize the issuance of the necessary bonds. The present popular clamor in Chicago, however, is ample proof that the people would overwhelmingly favor a bond issue for any reasonable amount that would permanently prevent the recurrence of the recent conditions.

From these considerations it is apparent that the first requirement for satis-

factory disposal of the refuse of Chicago is that the city own and operate the plant or plants and all the appurtenances thereto.

¶ THE *disposal of garbage is only a part of the protection to public health. Rubbish and ashes while not so offensive are just as great menaces to health.*

Altho the recent disturbance in Chicago related particularly to the removal of garbage, no comprehensive plan for its disposal should be considered without also including the rubbish and ashes.

Garbage will decay in a short time, the activity of the putrefaction depending on the temperature. We now know that decaying garbage offers the best field possible for the breeding of flies and other germ carriers, as well as of the germs themselves. It is for this reason that garbage dumps are a ghastly menace to the public health altho the popular clamor against them is generally because of their odor. Household rubbish, bacteriologists have determined, contains millions more germs than garbage and they are more dangerous. Rubbish must be infected by every contagious disease in the community and its proper disposal is as important to sanitarians as that of garbage. However, because it is seldom objectionable on account of stench, it is neglected as a nuisance in the popular mind. It can fairly be compared to the moccasin of the South which strikes without warning while garbage is similar to the more generous rattler who gives warning altho his bite is equally poisonous.

Ashes are innocuous but this pure mineral waste is never found to exist without contaminating matter. At present Chicago collects all the rubbish mixed with the ashes. At first glance it would seem that if the rubbish were separated from the ashes the latter could be dumped, but a careful inspection of such dumps in all parts of the country proves that it is impossible, practically, to prevent garbage and rubbish becoming mixed with the ashes. The more wealthy people exercise greater care, while the poorer classes are much more negligent in properly casting off their smaller proportionate quantity. The official records for the last year show that the garbage collected as such was only 17 per cent. of the total refuse. Careful investigations show approximately 25 per cent. of the total refuse to be garbage, so that 8 per cent. of the total garbage as well as all the rubbish has been dumped. This condition should not be tolerated in the permanent method of disposal. The only positive way of obtaining complete sanitation is to sterilize the ashes as well as the rubbish and the garbage.

Refuse collection is so closely related to refuse disposal that the method adopted for one should practically control the decision as to the other. Collection is even more important than disposal. Every householder and even transient pedestrian suffers from a complex and inferior collection service. The performance of the disposal plant, however, is of greater interest to its immediate neighborhood than to the citizens at large. Again the annual cost of collection is much greater than the cost of disposal.

¶ COLLECTION *methods classified in three divisions, and a description of each.*

The methods of collection may be classified in three divisions, i. e., the three, two and one-can systems.

Under the best regulations for the three-can system a large metal barrel is adopted for the ashes, a small metal pail with tight fitting cover is used for the garbage, and a box or other suitable container is supplied for the rubbish. A perfect separation is impossible and the attempt to make it is a great inconvenience to the householder. Its only advantage is that more frequent collection may be made of the garbage than of the rubbish and ashes. Collection requires three different types of wagons, ashes generally in one-horse two-wheeled carts of 1 or 1½ cubic yards capacity, rubbish in two-horse four-wheeled wagons with high sides and capacity of about 6 cubic yards, the garbage in steel bodied wagons, one or two-horse, watertight and with snugly fitted covers.

As to methods of disposal under this system. Garbage is invariably reduced by steam, pressure, or gasoline, 3 to 5 per cent. of grease redeemed and the 12 to 15

per cent. of residue used as a fertilizer base. On account of the nature of this reduction process the plant is objectionable in that fumes and odors are emitted from it, and it must therefore be far removed from any residential district.

The rubbish may be picked for salable material and the residue burned or the entire mass may be incinerated. The records of some of the foreign picking and incinerating plants show a good profit is derived from this system but so far the best results in this country, due to the higher rates of wages, have only supplied an income sufficient to cover all the costs of operating the plant. The most objectionahle feature of this three-can system is that the household ashes, containing as they must an appreciable proportion of the garbage and rubbish, are dumped on the nearest low-lying ground, generally adjacent to dwellings, which results in contaminating the neighborhood, thru the breeding of flies and germs, second only to the garbage dump. Disease is also spread by the picking over of these dumps and the consequent use of material not sterilized. Ground created by ash dumps is not satisfactory for building purposes because the ashes settle in time and do not offer a sufficiently stable foundation and excavation in such ground is dangerous to health.

The two-can system has two sub-divisions. In one of these the ashes are collected separately as in the former system and the rubbish, discarded in the same receptacle with the garbage, is collected by the same wagon. This system requires less care in separation but offers less variation in the frequency of collection. However, a quite sanitary disposition of the garbage and rubbish can be effected by incineration, but the system, altho adopted to a large extent by the smaller cities of this country, does not obviate the disease breeding ash dump and can therefore be considered as unsatisfactory without further investigation.

The second sub-division is more interesting. It is the system in use in Chicago in the past. By it the garbage is deposited in a separate metal receptacle with a cover and collected by an iron-bodied water-tight wagon fitted with a top to make it as odor tight as possible. The rubbish is discarded with the ashes and this mixture hauled to the point of disposal in the same scavenging wagon. The garbage is reduced and the by-products of grease and tankage are obtained with large profit less some expenditures to be deducted for comparison with other systems. It has been the custom to dump the rubbish and ashes under this system, but they may be burned in an incinerator, producing steam for power as a by-product.

The one-can system requires but one receptacle for all garbage, rubbish, and ashes. The great convenience to each housekeeper is apparent. Improved sanitation commences at the kitchen in that the putrefaction of the garbage is arrested by the mixture of the garbage with the ashes, which also prevents the can from freezing in cold weather as the ashes will absorb the free moisture of the garbage, preventing flying dust from the ashes and leakage of can. Only one type of wagon is required which may be of various sizes from one-horse carts to ten-ton motor trucks as congestion of population suggests. Night collection may be adopted as one can outside each dwelling will not seriously obstruct the sidewalks. Inspection is more readily and cheaply made. The cost of collection is in direct proportion to its frequency. As the putrefaction of the garbage is arrested hy the ashes daily collection is not demanded except where the amount requires, and a reduction in cost is realized without decreasing the sanitary features.

Disposal under this system is effectde by high temperature incineration or destruction. The mixture of garbage, rubbish and ashes is burned by pre-heated forced draft and reduced to a hard vitreous clinker. This residual is of value as it is a practical substitute for broken stone for road foundations and, when crushed, for concrete work, such as culverts, curbing blocks or sidewalk slabs. The combustion is so complete that the plants are not only guaranteed to operate without smoke or odor, but steam power is generated

The only satisfactory systems to he considered for Chicago are therefore the two-can system under which the garbage is

reduced and the ashes and rubbish are incinerated, and the one-can system with the incineration of the entire refuse. On account of the marked advantages in collection as stated above in detail and the decidedly superior atmosphere of the incinerator over the reduction plant, the latter is admittedly the more sanitary method of the two. Their economic superiority must be determined by comparison. Using the quantities as given in the last published official report the following tabulation is made for discussion:

cent. municipal bonds could be sold at par.

Depreciations and repairs are taken at 10 per cent. as a fair figure from the available records of municipally owned reduction plants, which is conservative when the amount of money requested to put the present private plant in complete repair is recalled. The life of reduction machinery is not so long as could be desired and history recalls many serious fires which either completely demolished the plants or caused heavy expense for renewals.

System—Reduction of garbage and incineration of ashes and rubbish under two-can system of collection.

Garbage.	*Cost.*	*Income.*
Collection, 117,775 tons, at $3.25	$382,768	
Interest on $900,000, cost of plant, at 4 per cent	36,000	
Depreciation and repair, at 10 per cent	90,000	
Income from by-products, at $1.00 per ton		$117,775
Ashes and Rubbish.		
Collection, 568,735 tons, at $1.00	568,735	
Interest on $2,000,000, cost of plant, at 4 per cent	80,000	
Depreciation and repair, at 5 per cent	100,000	
Labor for operation, at 25c	142,184	
Steam power		426,551
Clinker, 142,000 tons, at 25c		35,500
Totals	$1,399,687	$579,826
Annual cost	$ 819,861	

System—Incineration of garbage, rubbish and ashes under one-can system of collection.

Refuse.		
Collection, 686,510 tons, at $1.00	$ 686,510	
Interest on $3,000,000, cost of plant, at 4 per cent	120,000	
Depreciation and repair, at 5 per cent	150,000	
Labor for operation, at 25c	171,630	
Steam power		$411,906
Clinker, 137,300 tons, at 25c		34,325
Totals	$1,128,140	$446,231
Annual cost	$ 681,909	
Difference favoring complete incineration	$ 137,952	

We will discuss each item in detail.

The collection cost for garbage, separated from the rubbish and ashes is taken at $3.25 per ton. There is no record of this cost ever being below $3.62, but it is believed that previous figures may be reduced by the adoption of motor trucks and improved loading stations. In any event the rate taken is generous to the reduction system.

The cost of a reduction plant of 1,200 tons daily capacity has been stated to be $900,000, and it is considered that 4 per

The value of the by-products is the basis of all arguments favoring the reduction system. The income to be derived from them has been exaggerated by some prejudiced minds and depreciated by others equally prejudiced, but it is believed from a careful study of the best records available that one dollar per ton net in excess of the cost of labor will be a fair sum to use for calculation.

The records show the cost of collection of ashes and rubbish to have averaged between $1.38 and $1.45 per ton. At this

cost the material was hauled great distances to dumps and it is fair to assume that if the haulage was decreased by the erection of centrally located disposal plants, this cost would be reduced at least one-third. It has, therefore, been taken at $1.00 per ton.

The cost of incinerating plants of 2,500 tons daily capacity is estimated at $800 per ton, and hte interest rate is taken as before.

Practically all of the incinerators are municipally owned and inspection may be made of many accurate records of their performance. From a large amount of such data their life is estimated at 20 years and cost of repairs at ½ per cent. per annum, or 5 per cent for depreciation and repairs.

From similar records it is believed that a labor cost of 25 cents per ton would be expected under operating conditions in plants of as large capacity as would be suitable for service in Chicago.

The records of incinerating plants in producing steam power show that the evaporation varies directly as the quality of the material to be burned. Ashes and rubbish will have a low amount of moisture and will average considerably higher in calorific value than when mixed with garbage. It has therefore been considered that an evaporation of two pounds of steam per pound of material should be expected as a constant and reliable product. The conditions in Chicago peculiarly adapt themselves to the utilization of this power. The many pumping stations scattered thru the city are ideal points for this utilization. These plants have been located as centers of distribution for divisions of the city and property immediately adjacent to them would therefore be at the center of haulage for a district which is not identical would be approximately the same. There is thus a consumption waiting for all the steam generated. The valuation of this power has been estimated by the coal it would supplant. Considering the value of coal as $2.50 a ton delivered at the stations and 50 cents a ton as the cost of stoking and that an evaporation of 8 pounds is obtained, the equivalent value of material evaporating 2 pounds would be 75 cents per ton.

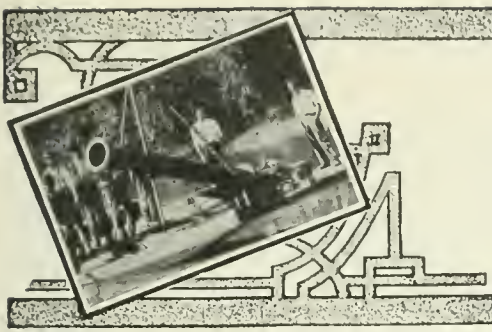
An estimate of the value of clinker without any well defined utilization of it is difficult. This residue from the combination of ashes and rubbish alone would be about 25 per cent. of the total tonnage. Fully one-half of this taken from the average day's burning would be an entirely suitable substitute for crushed stone for any concrete work aud is particularly adaptable for sidewalk slabs and curbing blocks. However, it cannot be denied that much of this residue is only serviceable as fill, altho entirely sanita and its value has therefore been taken as 25 cents per ton.

The details of the figures tabulated for complete incineration with the one-can collection system are generally similar to those given for the incineration of ashes and rubbish. The $3,000,000 investment is based on plants with a total disposal capacity of 3800 tons per day, which would seem proper. The evaporation resulting from burning the garbage as well as the ashes and rubbish would naturally be lower than if the latter materials were burned alone. The amount of steam generated as dependable power has, therefore, been taken as only 1.6 pounds, or one-fifth the value of coal. This gives an equivalent evaporation value of 60 cents per ton. The proportion of clinker resulting from the combustion of the mixed refuse would also be less than that obtained from the ashes and rubbish, and this has been taken at 20 per cent of the total tonnage.

CONCLUSION.

The best solution of the refuse disposal problem in Chicago requires that the plants should be municipally owned.

From a sanitary and economic comparison, complete incineration is now seen to have many advantages. Added to its other advantages is the fact that the by-products derived from it may be directly utilized by the municipality and the revenue is, therefore, not influenced by the fluctuating market of commodities not always in demand. This system has been adopted in London, Paris, Berlin, St. Petersburg and all of the larger cities abroad; it is also in use on the outlying districts of New York, and has recently been decided upon for San Francisco.



EDITORIAL

COMMISSION GOVERNMENT FOR CITIES

Mr. Bradford's article on "Twelve Years of Commission Government," elsewhere in this number gives a very good idea of the development and change in the ideas concerning the method of governing cities bearing this name. It is very evidently a materially different plan now from that first proposed by Galveston, and really first used in Memphis, Tenn., when that city had to be pulled out of its financial troubles following the historic epidemic. From appointment by a governor presumably for efficiency and competence in their respective offices to election without reference to particular experience in their offices was the first long step downward, required by the constitution of the state of Texas. All the changes made since that time have been made really for the purpose of throwing proper safeguards around the acts of the body of commissioners which was thus made into the old city council without control of a mayor, which has long been considered to be a discredited form of government in this country, tho reasonably successful in England. The latest development is that which is put into most definite form in the new charter of Dayton, O., and will go into effect in January. The commission is there a legislative body which must delegate its executive and administrative powers to a city manager employed by itself. This carries out the business analogy so often drawn and there are great hopes of its success.

Dayton can still become the prey of the politicians if its citizens lose interest in their common business and leave it to the manipulation of those who find a personal benefit in such operations and are not above taking advantage of the indifference and apathy of their fellow citizens. Business is business and must be attended to if it is to be done right.

APPRECIATION OF LAND VALUES IN VALUATION OF PUBLIC UTILITIES

There is a tendency in court and public service commission decisions in determining the present valuation of properties for the purpose of fixing rates, to allow any increment of value of real estate which may have accrued above the original cost of such real estate. This is one item in a complex system of items and its treatment is likely to be from analogy with other items rather than based on a consideration of its own merits.

It is a principle of a considerable number of political economists that all increment of real estate values belongs to the public rather than to the

individual who happened to own the real estate during the time of increase in its value. Whether this is a correct principle or not does not really affect real estate of public service corporations. In their case the basis is somewhat different.

The public service corporation is formed to perform a service for the public, collectively or individually, or both, and is, or, in most cases and for economic reasons, should be granted a monopoly of such service. It is entitled to an adequate return upon the money and the financial and technical ability invested in the business and proper sinking or depreciation funds, and it is entitled to no more. The increase in value of its real estate is ordinarily due to the development of the community in which it is located and has nothing to do with the measurement of the adequate return referred to, and it should not be considered in determining what the value of the plant is upon which this adequate return must be computed.

This is perhaps the most obvious item of several, the unscientific treatment of which by the public utilities commissions is increasing valuations of plants and rates for service unduly and unjustly.

BOND ISSUES FOR STATE HIGHWAY CONSTRUCTION

It is reported that the plan for issuing $50,000,000 in bonds for building roads in Pennsylvania has been defeated with a small majority by the country vote, the cities, particularly Philadelphia, voting largely for the bond issue. There are two or three reasons for this defeat. One is undoubtedly the experience of New York in the waste of a large part of its first fifty million issue on account of the difficulty of securing an efficient organization, due to political manipulation, the influence of grafters and the inefficiency of the men put in charge under these conditions. This was accompanied by a very strong doubt of the ability of a Pennsylvania state government to administer such a fund honestly and efficiently, in the light of the state's experience in the past. Another is the unwillingness of the country taxpayers to aid in the construction of fancy automobile race courses for the city speed fiends. The value of the road to the general agricultural, mineral and manufacturing interests of a state like Pennsylvania, which is so vastly greater than the convenience for the pleasure driver, is not considered because the average country property owner, even if he owns some of this valuable undeveloped property, does not know the possibilities of development. If he owns simple farming land of none too great fertility he is still less likely to see the wonderful influence which this general development would have upon his own condition. These things are a matter of education and object lessons are the only methods of bringing them home. There are such object lessons in other states, but the vision of so many people is limited by the boundaries of their own state that it seems necessary to devise some means of constructing enough of a system to demonstrate its possibilities before the taxpayers at large are willing to establish the system as a whole. This has been the history of all such movements; first apathy and active opposition, overcome as to some particular case; then growth of popularity of the plan until the former objectors range themselves in a waiting line to get their share of the demonstrated benefits.

Make haste slowly, develop the organization as the needs demand and supply it only with the money which it has learned how to spend, are good principles to work upon. Massachusetts, Connecticut, New Jersey, Ohio are more or less excellent examples of their correctness.

QUESTION DEPARTMENT

Southern Cities with Filtered Water Supplies

Will you please give me a list of the cities in the South which have purification plants or treat their water in any manner before pumping it to the consumer.

J. F. Carter, Jr.,

The following cities filter their water unless otherwise noted:

Plants under private ownership: Birmingham, Ala.; Chattanooga, Tenn.; Carthage, Mo.; Columbus, Ga.; Durham, N. C.; Gadsden, Ala.; Huntington, W. Va.; Joplin, Mo.; Knoxville, Tenn.; Little Rock, Ark.; Lexington, Ky.; Louisville, Ky.; Macon, Ga.; Milledgeville, Ga.; Morgantown, W. Va.; Mexico, Mo.; Paducah, Ky.; Shreveport, La.; St. Joseph, Mo.; St. Louis, Mo. (treats its water to produce sedimentation of impurities); Sedalia, Mo.; Texarkana, Ark.; Wilmington, N. C.; Winchester, Ky.

Plants under municipal ownership: Athens, Ga.; Atlanta, Ga.; Augusta, Ga.; Clarksville, Tenn.; Danville, Ky.; Eufaula, Ala.; Meridian, Miss.; Norfolk, Va.; Nashville, Tenn.; Petersburg, Va.; Salisbury, N .C.; Savannah, Ga.; Washington, D. C.; Wilmington, Del., in part and has an emergency hypochlorite plant.

Blow Off Pipe for Wooden Water Main

I would like to know if there is an apparatus or an appliance by which a wood water pipe line could be drained if constructed as an inverted siphon. The water when entering the pipe is full of sand and mud, and, of course, leaving the first hill from the canal into the pipe would run with considerable force until it struck the next hill, and what I desire to know is whether or not it is possible to take out of the pipe the mud which would naturally collect at the lowest point in the pipe, or whether it would be impracticable to build such a pipe line when you have muddy water nine months in the year to contend with. Kindly refer us to some manufacturer of wood pipes who would be willing to contract a job of this kind and guarantee their work.

O., Mayor, ———, Utah.

Blow-off pipes for such service as that desired are desirable at every low place in the grade line of the pipe and are necessary with water carrying a large amount of sediment. They are supplied, with the proper connections, by any makers of wood pipe, such as the Wyckoff Pipe and Creosoting Co., of Elmira, N. Y., Byrne-Turner Co., Bellingham, Wash., National Wood Pipe Co., Portland, Ore., Pacific Coast Pipe Co., Seattle, Wash., Pacific Tank and Pipe Co., Los Angeles, Cal., Portland Wood Pipe Co., Portland, Ore., Redwood Mfrs. Co., San Francisco, Cal., J. A. Soderberg & Co., Seattle, Wash., Washington Pipe & Foundry Co., Tacoma, Wash.

The difference of level between the entrance to the pipe and the lowest point must not give a greater pressure than the pipe will stand. This depends on the design of the pipe and the care taken in constructing and maintaining it and may be for some designs about 125 pounds. The pipe should be designed and its construction supervised by a competent engineer with experience in such work.

Library on Municipal Engineering

Where can I purchase a good set of books on municipal engineering? Can you supply bound volumes of Municipal Engineering?

Mgr. Industrial Div., Association of Commerce, New Orleans, La.

K., ———, Minn.

Municipal engineering is such a large field that a library covering it would include books on almost every engineering subject. Surveying, paving, sewers, sewage disposal, water supply, water purification, lighting, garbage and refuse disposal, parks and playgrounds, bridges, foundations, each has its list of books, some of them quite long. The back numbers of Municipal Engineering contain many longer or shorter lists of books on these subjects and on special lines within them. Bound or unbound volumes of Municipal Engineering can be furnished for

some ten years back, with but few exceptions, and in themselves form a very complete library upon the modern developments in the field.

Such a book as Maxwell and Brown's "Encyclopedia of Municipal and Sanitary Engineering" ($10) gives a view of the subject from an English point of view and will indicate to the reader the courses which his reading should take, with some encyclopedia information in each line to aid him in his choice of further reading matter.

Such a book as Whinery's "Municipal Public Works" ($1.65) treats the subject rather from the point of view of the administrator and lays down the principles upon which the carrying on of such work should be based.

Such a book as McCullough's "Engineering Work in Towns and Small Cities" ($3) treats the subject from the opposite point of view and gives many interesting and valuable pointers as to methods of carrying on work from the point of view of the municipal engineer in the field.

If the lists of books referred to are not available, the editor will furnish suggestive lists upon any of the lines mentioned above, with such descriptions of the books listed as may be available to give an idea of their scope and comparative value.

Drainage Districts in Cities

Will you kindly advise me how general the practice is thruout the United States of formulating drainage districts within municipalities so that the construction of culverts, inlets, ditches, pumping stations, etc., is carried on at the cost of the area contributing the run-off to be handled? Just a list of some of the municipalitise or states in which this is a law is all that is required.

P., ———, Tenn.

There are three general methods of making assessments to meet the cost of constructing sewers and drains and their appurtenances besides the method of adding the cost to the general assessment for taxes so that it is paid by the city at large as other taxes are paid, in proportion to the property valuation. In each of the three cases there may be a combination whereby the general funds of the city are called upon to pay a part of the cost. The assessments made by these three general methods may be made in proportion to valuation, to area, to frontage, to benefits, or otherwise, or by any combinations of these varieties.

In the states of Arkansas and Louisiana, except New Orleans, sewer districts are established which are entirely independent of the city, have their own commissioners and engineers, do their own construction work and assess the cost upon the district in one way or another of those mentioned. This method is apparently not satisfactory, certainly not in Little Rock, Ark., with the conditions in which the writer is acquainted.

California, Colorado and Idaho establish sanitary districts, those in California and Colorado being established by separate action of the people interested, but when established, the work is placed in charge of the city's public works officials. In California the cost is assessed on the sanitary district according to valuation, in Colorado according to area, and in Idaho according to benefits.

In most states the city public works departments or the city councils have the only power to institute proceedings for the construction of sewers and drains, but in most of these states it is provided that the assessment of cost shall be upon the district benefitted, except so far as the city may contribute from its general funds. The city is thus divided into districts according to the watersheds of the drainage systems or sewerage systems and each district pays for its own sewers or drains and is not assessed for those constructed in other districts, except so far as the city's contribution from its general funds is concerned. The Indiana method is apparently the simplest in theory and works out well in practice. There are several states using the same theory, but it is not so clearly stated in their statutes. In brief, each sewer or drain, when constructed, has its cost divided into two parts; one is the cost of an adequate local sewer or drain to serve the property adjacent to the line of the sewer; and the other part, the remainder, is taken as due to the necessity of draining all the property belonging to the drainage district which the sewer or drain will serve when the entire system is constructed. The former is assessed upon the adjoining property only; the latter upon the entire district including the adjoining property. When a system is constructed in parts, beginning at the outlet, a certain piece of property in the upper part of the district may be so situated as to have several district assessments, one for the main outlet sewer serving the whole district, and one or more for branches and secondary branches of this main sewer, the last assessment in the line being for the sewer serving the property directly, which is probably a local sewer only and therefore causes no district assessment but only the local assessment on the adjoining property directly benefitted by it. Intercepting sewers, sewage disposal works or other additions to the system may be constructed from time to time and their cost will be assessed in the same way.

There is a peculiar development in Illinois which can scarcely be classified under either of the three methods of forming sewerage or drainage districts, tho partaking largely of the characteristics of the

first. It may have been influenced by the treatment of the Sanitary District of Chicago, which was formed for the special purpose of disposing of the sewage which had formerly drained into Lake Michigan and is independent of the city in its organization, but has nothing to do with the sewerage or drainage systems proper within the city, except to take the discharge from them and carry it away from the city. The funds for this purpose are raised by general taxation over the whole district. The method referred to has been devised in connection with the drainage laws of the state. These provide for the formation of drainage districts for the construction of ditches and drains into those ditches, the cost being assessed upon the property benefited. In at least one case the attempt has been made to extend the operation of the law by means of an extension of the work of the original district so that this branch of the main ditch becomes a system of underground storm water drains, serving the area on which two adjoining cities are located. Each city has a separate system of sanitary sewers so that the proposed system will not carry sewage. It is proposed to assess the cost of this system of storm water drains on the property benefitted in the same manner that farm lands have been assessed for the main and branch ditches constructed thru them or draining them. Indiana has similar drainage, levee and stream cleaning laws, but they have never been applied to the construction of storm water drains other than ditches in cities.

The Economical Suction Lift for a Pump

A pump is pumping about 600 gallons of water per minute from a well or wells with the water level about 15 feet below the piston level of the pump, or in other words, a 16-foot lift pumping against 100-foot head. If the pump should be lowered 14 feet, thereby bringing the suction line that much nearer to the water level of the wells and increasing the head to 114 feet, would there be any saving by so doing, if so, how much?

SUPERINTENDENT OF WATER WORKS,
———, N. Y.

This subject is quite thoroly discussed in Turneaure's "Water Supply Engineering," page 667. Within the limits of the power of the pump to draw water readily by suction, namely, somewhat less than 30 feet, there seems to be but little difference in cost of operation by raising or lowering the pump so as to increase or decrease the suction lift, provided the total lift is the same. There are, of course, questions of leakage, gases in the water and ease of entrance of water into the suction line, etc., which may modify this general conclusion in any particular case, but ordinarily within about the limits named there would be very little, if any, difference in the cost of pumping, whether the suction was 16-ft. lift or 2-ft. lift, the total lift being 116 feet in either case, unless the difference of cost came in on account of the differences in cost of construction or protection from overflow, or pipe connections, both steam and water, such matters relating to the setting of the pump rather than the simple lifting of the water.

Standard Purity of Potable Water

Will you please advise, through your Question Department if the United States or any state has a standard of purity for potable water.

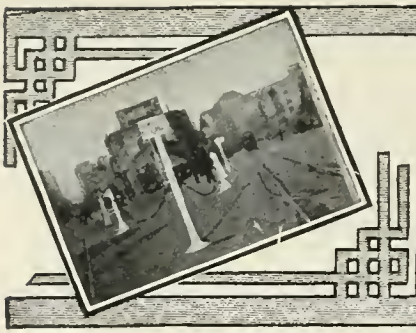
A., Superintendent of Water Works,
———, N. Y.

No state has an official standard of purity for potable water, and the United States attempts no control of potable waters except for its own employes. The point of view of the states is well expressed in the following extract from the report on water and sewage purification in Ohio, made by the State Board of Health in 1908:

"The efficiency of water filtration, or the degree of usefulness of the process, is measured by what may be termed the wholesomeness of the final product. A wholesome or safe water may be defined as one which contains no disease producing qualities and which is clean in appearance. A water may be considered safe when the bacterial life has by filtration been so largely eliminated that it is as pure as water from the best natural sources of supply.

"The total number of bacteria per cubic centimeter in the filtered water is a factor in determining its wholesomeness; and the presence or absence of the colon bacillus, which is indicative of recent sewage or animal pollution, is an important guide. A still more important index is the quantitative analysis for colon bacilli, by which is indicated the amount of sewage pollution. *No sharp distinction can be drawn between a safe and an unsafe water. The analysis must be considered in connection with all conditions relating to the source of the sample and its subsequent treatment.*

"The physical characteristics of the filtered water are an important factor also in determining the efficiency of filtration. It must be free from turbidity, color, tastes and odors in order to be considered satisfactory or wholesome. Altho a water will not directly cause disease on account of its poor physical characteristics, it will not be depended upon for drinking by any large number of people and may, therefore, necessitate the use of well waters which are often contaminated tho clear in appearance."



WORKERS IN THE FIELD

Rates for Berkeley, Cal., Electric Light

The Editor of MUNICIPAL ENGINEERING:

Sir—In the early days the city of Berkeley owned a municipal electric lighting plant. This has depreciated until practically nothing is left of the old plant. The Pacific Gas and Electric Company supplies us with electric power and light and attached hereto is a copy of an ordinance fixing the rates for the coming fiscal year. The company pays to the city for the lease of the old plant and privilege of doing business in this city 3 per cent. of its annual income. This income is practically $7,000 per year, which we receive in the nature of rent for the use of our old electric lighting plant.

W. J. SEABORN.
City Clerk, Berkeley, Cal.

The ordinance follows:

Be it ordained by the council of the city of Berkeley as follows:

Section 1. That the rates of compensation to be collected by any person, firm or corporation in supplying electric current to the inhabitants of the city of Berkeley during the year beginning July 1, 1913, and ending June 30, 1914, are hereby fixed and determined as follows:

(a) The rates of compensation for supplying electric current for incandescent electric light for domestic purposes shall be as provided in the following schedule of rates:

For the first 50 kilowatt hours of electric current consumed in one month, 7 cents per kilowatt hour.

For electric current consumed in one month in excess of 50 kilowatt hours and not in excess of 150 kilowatt hours, 6 cents per kilowatt hour.

For electric current consumed in one month in excess of 150 kilowatt hours and not in excess of 250 kilowatt hours, 5 cents per kilowatt hour.

For electric current consumed in one month in excess of 250 kilowatt hours and not in excess of 400 kilowatt hours, 4 cents per kilowatt hour.

For all electric current consumed in one month in excess of 400 kilowatt hours, 3 cents per kilowatt hour.

Provided, however, that no bill for electric current per meter shall be less than $1.00 per month.

(b) The rates of compensation for supplying electric energy for commercial purposes shall be as provided in the following schedule of rates:

For the first 300 kilowatt hours of electric current consumed in one month, 4 cents per kilowatt hour.

For electric current consumed in one month in excess of 300 kilowatt hours and not in excess of 5,000 kilowatt hours, 3 cents per kilowatt hour.

For electric current consumed in one month in excess of 5,000 kilowatt hours and not in excess of 10,000 kilowatt hours, 2½ cents per kilowatt hour.

For all electric current consumed in one month in excess of 10,000 kilowatt hours, 2 cents per kilowatt hour.

Provided, however, that no bill for electric current per meter shall be less than $1.00 per month.

(c) The rates of compensation for supplying electric energy for general power purposes shall be as provided in the following schedule of rates:

If the monthly consumption per horse power is above the minimum and less than 108 kilowatt hours, 3 cents per kilowatt hour.

If the monthly consumption per horse power equals 108 kilowatt hours and is less than 216 kilowatt hours, 2½ cents per kilowatt hour.

If the monthly consumption per horse power equals or exceeds 216 kilowatt hours, 2 cents per kilowatt hour.

Provided, however, that no bill for electric current shall be less than $1.00 per month for each horse power in motor or motors installed.

Section 2. The rates fixed and determined by this ordinance shall be maximum rates to be charged for supplying electric energy for lights or power purposes to the inhabitants of the city of Berkeley for said year. Any person, firm or corporation supplying electric current

for any of the aforesaid purposes may voluntarily lower the rates herein fixed, and, in the event of such reduction, the reduced rates so fixed shall apply equally to all persons in the class of consumers in which any such reduction of rates is made.

Section 3. Any person, firm or corporation, or any officer or employe thereof, wilfully violating any of the provisions of this ordinance shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine of not less than $300; the judgment imposing the fine may provide for its collection by imprisonment in the county jail of Alameda county, at the rate, in the manner and for the time provided by law.

Section 4. This ordinance shall take effect and be in force on July 1, 1913.

Suggestions for Improvements on Bacterial Filtering Beds for the Purification of Sewage

The Editor of MUNICIPAL ENGINEERING:

Sir—In the October number of MUNICIPAL ENGINEERING you published a communication, with drawing, containing suggestions for a ventilated spraying and darkening chamber in connection with sewage filtering beds. These suggestions have been criticized as being too costly to carry out.

The fact is recognized, of course, that in many localities the time is not far distant when the disposal of sewage will require as thoro and as scientific handling as the purification of our domestic water supplies, for the two problems are rapidly and increasingly interweaving. Within certain limits, under these circumstances, the original cost of installing any sewage purifying plant will not be as seriously considered as will perfection of results.

In order to determine intelligently whether filtering beds are ultimately entitled to a place in sewage purification plants, it may become necessary to learn the relative efficiency and the cost of installation and operation of a highly developed bed.

In cases where there is a surplus fall of from 10 to 15 inches between the outfall of settling tank and the top of filtering bed, as ordinarily constructed, the results expected to be accomplished by the "ventilated, spraying and darkening chamber" might, in a measure, be brought about with less expense in the following manner:

On the crushed rock of the filtering bed place a layer of, say, cedar blocks, similar to the old style, round paving blocks, having a measurement of from 4 to 6 inches in length. These blocks are to be strewn over the bed to a depth of from 10 to 15 inches. This covering is supposed to do its greatest good in cold weather.

The sprayed effluent of the settling tanks would, on account of the larger interstices between the blocks, flow readily to the surface of the crushed rock underneath, where the warmth and darkness resulting from the presence of the block covering would sustain bacterial life better than if the wooden blocks had not been superimposed. The occasional clogging of the filter bed at the surface of the crushed rock, and the odor resulting from such clogging, would probably be reduced to a minimum. The wood might decay too rapidly, however, for practical results, in which case round stone of from 4 to 6 inches in diameter might answer the purpose nearly as well. On the other hand, being a better non-conductor, the blocks, by conserving more of the warmth of the upper layer of crushed rock, might increase the efficiency of the bed adequately, to offset the cost of wood over stone.

Unavoidably warmth would escape from the sprayed liquid as it passes down over the wooden blocks, and, in addition, other changes might occur that do not take place in unprotected beds of crushed rock. If the layer of blocks is too deep, it might be that bacterial slime will form on them and, should it slough off in large flecks from time to time, it might clog the surface of crushed stone. The formation of slime in excessive quantity would hardly be expected if the layer of wood were not over 10 or 15 inches deep. However, whether this loss of warmth would be serious or whether any other possible changes would result from this plan must doubtless be determined by experiment.

WILLIAM THUM,
Pasadena, Cal.

Cost of Recutting and Laying Granite Block Paving

The Editor of MUNICIPAL ENGINEERING:

Sir—The following table gives a summary of the cost of resurfacing Albany street, in Schenectady, N. Y., between Veeder avenue and Hulett street, except street railway track. The work consisted of removing and disposing of the old asphalt block wearing surface, repairing and adjusting the old concrete foundation, recutting the old 4 by 8 by 12-inch granite blocks from Lower State street to 4 by 4 by 6-inch new granite blocks, dressing same and laying them in 1:4 portland cement mortar bed, with 1:2 portland cement grout and surface plaster. This report covers the 2,319.78 square yards of work completed between June 2 and September 12, 1913.

Detailed Description of Work.	Total Cost.	Cost per Sq. Yd.	Cost of Labor.	Cost per Sq. Yd.	Cost of Teams.	Cost per Sq. Yd.	Cost of Mtls.	Cost per Sq. Yd.
Labor ripping up old asphalt blocks	$ 163.18	$0.0703	$ 163.18	$0.0703				
Team hire hauling blocks to yard and dump	111.29	.0480			$111.29	$0.0480		
Labor leveling off old foundation	18.28	.0079	18.28	.0079				
Total grading cost	$ 292.75	$0.1262						
Labor mixing and placing cement patches	$ 92.30	$0.0398	92.30	.0398				
Cement deliver on the Job and stacked	51.98	.0224					$ 51.98	$0.0224
Sand delivered on the job and dumped	2.05	.0008					2.05	.0008
Stone delivered on the job and dumped	21.42	.0092					21.42	.0092
*1 Total cost of patching old concrete base	$ 167.75	$0.0722						
Labor mixing and placing mortar bed	$ 122.15	$0.0526	122.15	.0526				
Cement delivered on the job and stacked	228.41	.0984					228.41	.0984
Sand delivered on the job and stacked	49.27	.0212					49.27	.0212
*2 Total cost of 1:4 cement mortar bed	$ 399.83	$0.1722						
Labor loading granite blocks for yard	$ 18.01	$0.0078	18.01	.0078				
Team hire hauling granite blocks to yard	15.00	.0065			15.00	.0065		
Labor piling granite blocks in yard	48.38	.0209	48.38	.0209				
Labor sharpening tools	62.44	.0269	62.44	.0269				
Materials sharpening tools	4.00	.0017					4.00	.0017
Labor cutting and dressing granite blocks	1,631.26	.7031	1,631.26	.7031				
Team hire hauling cut blocks to street	124.00	.0538			124.00	.0535		
Labor hauling blocks to pavers	85.75	.0370	85.75	.0370				
Labor paving and ramming blocks	384.38	.1657	384.38	.1657				
*3 Total costof recutting, dressing and laying granite surface	$2,373.22	$1.0231						
Labor mixing and placing cement	$ 139.78	$0.0603	139.78	.0603				
Cement delivered on the job and stacked	169.77	.0732					169.77	.0732
Sand delivered on the job and dumped	23.24	.0100					23.24	.0100
Total cost of 1:2 cement grout joints and surface	$ 332.79	$0.1435						
Labor, superintendence	$ 186.76	$0.0805	186.76	.0805				
Labor, watchmen	193.50	.0834	193.50	.0834				
Total overhead cost	$ 380.26	$0.1639						
Labor	$ 1.13	$0.0005	1.13	.0005				
Team hire	16.33	.0070			16.33	.0070		
Materials	6.00	.0026					6.00	.0026
Total cost of incidentals	$ 23.46	$0.0101						
Grand totals of costs	$3,970.06	$1.7112	$3,147.30	$1.3567	$266.63	$0.1150	$556.14	$0.2395

*1. The square-yard figure on patching old concrete base is not the cost per square yard of concrete patch, but the cost divided by the number of yards of completed pavement; and the sand that formed the cushion for the old asphalt block surface was used both for making concrete for patching and for mortar bed, which accounts for any seeming discrepancy in sand bought. The concrete was a 1:3:6 mixture of portland cement, the mortar bed a 1:4 mixture, and the joint grouting was a 1:2 mixture.

*2. The cement mortar bed had to be laid much thicker in places than would have been necessary had not the old concrete foundation been so unevenly graded that the bed for the block averaged from 1 to 4 inches deep.

*3. This figure includes the cost of cutting the blocks on hand, it not being practicable to take an inventory of the number of blocks in the piles in the yard and ahead of the pavers on the street. Only a small part of the blocks were hauled into the yard by the city; others hauled there by contractors removing same from other streets and storing them where directed by the city. This form of block paving is laid so evenly by the pavers that the only ramming is done by the men doing the grouting of the joints when this shows a high block.

The prices paid for labor per day of eight hours and for material for this work were as follows:

Foremen	$4.00
Assistant foremen	3.50
Granite block makers	5.00
Granite block pavers	3.00
Laborers and watchmen	2.25
Teams, wagon and driver	5.00
Horse, wagon and driver	4.00
Portland cement, per barrel f. o. b. cars	1.24
Sand, per ton f. o. b. bank	.25
Crushed stone, 1½-inch, per ton f. o. b. job	1.75
Crushed stone, ¾-inch, per ton f. o. b. sidetrack	1.30

NOTE.—This work on Albany street was done by men, excepting the block cutters and pavers, who had never before worked on street paving, under a foreman taken from the machine shop of the General Electric Company, and it was performed without, at any time, blocking traffic on the street or any of the cross streets or private driveways.

CHARLES A. MULLEN,
Superintendent of Public Works,
Schenectady, N. Y.

Cleaning Water Pipes

The Editor of MUNICIPAL ENGINEERING:

Sir—We have noted the question of M.,——, Ore., which appeared on p. 340 of the October number of MUNICIPAL ENGINEERING, and would add to your reply that we believe we are the only contracting company successfully engaging in the business of water main cleaning. We mechanically remove silt, sand and incrustation from water mains, restoring them to their original diameters and carrying capacities. The work is done by opening up the mains at intervals depending on the local conditions, inserting our mechanical cleaner, and either forcing this cleaner thru the main by means of the water pressure, or drawing the cleaner thru by means of a heavy cable and windlass.

We will be pleased to furnish detailed information upon request.

NATIONAL WATER MAIN CLEANING CO.,
New York City.

Patents on Springfield Sewage Disposal Details

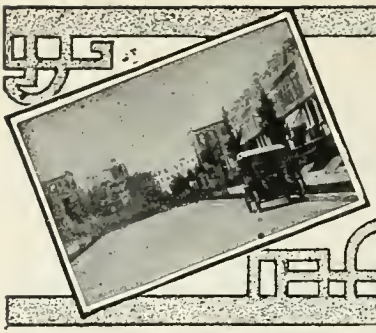
The Editor of MUNICIPAL ENGINEERING:

Sir—Referring to the article on "Sewage Disposal Plant at Springfield, Missouri," in your issue of November, 1913, we beg to call attention to the fact that the so-called "vertical circulation" is neither new nor original with Mr. Potter as it is an essential feature of the process set forth in our Travis and Ault (Hampton tank) patent, application for which was filed September 13, 1910. The "adjustable weir" which he uses for the regulation of this "vertical circulation" is also embodied in another of our applications for patents and follows the lines of explanations and information given by our engineer to Mr. Potter while he was designing the Springfield plant.

We notified the Mayor of Springfield on October 25, 1913, and Mr. Potter on October 27, 1913, that the tanks at Springfield were an infringement of the Cameron septic process and of the Travis and Ault (Hampton tank) patent, both of which are controlled by this company, and that we should take all necessary steps to protect our rights.

We call attention to these points that engineers and municipalities may know the facts and avoid any unintentional infringement of our patent rights.

STERILIZATION COMPANY,
Newark, N. J.



ROADS AND PAVEMENTS

Subways for Chicago

The city council of Chicago, Ill., is now wrestling with the problem of subways to relieve the unbearable congestion in surface traffic in the main business district and the serious difficulties in communication of various sections with each other outside the most highly congested district.

A report was made in September, 1912, by the Harbor and Subway Commission and a sub-committee of the council on local transportation which stated the basic principles and made the fundamental recommendations.

The principles, briefly stated, are that the plan must cover the transportation field of the entire city; that provision must be made for an increase in average number of rides per capita as well as an increase in population; that the capital cost of construction can be provided for out of future earnings; that the subways should be under absolute municipal ownership and control, tho their operation may be leased; that one five-cent fare must carry a passenger from any part of the city to any other part; and that ample provision must be made for future expansion.

The recommendations were of the locations of the trunk lines for first construction; of raising money for construction by municipal bonds with sinking fund for their extinguishment provided for from the surplus earnings, or letting contract for construction to private capitalists, which will provide for ultimate municipal ownership under the same sort of provisions and for complete municipal control at all times.

A supplemental report by the Harbor and Subway commission, dated October 30, 1912, replies to criticisms of the former report, giving facts and figures to refute arguments that the surface lines can be developed to care for the business; that the subways can not support themselves from their revenues; that the subways will increase rather than decrease the congestion in the loop district; that they will build up the loop district at the expense of outlying business and residential districts; and that contracts with private corporations will provide genuine rapid transit.

The third document in the series is a communication to the city council from Mayor Carter H. Harrison, transmitting two ordinances for their consideration.

In this communication the mayor states his conviction that the only way to get a comprehensive subway system is to invoke private capital under terms and conditions safeguarding public rights. The two questions which he thinks should be decided by the voters of the city are put in the form of ordinances, the first of which provides for a downtown subway along designated routes to be paid for out of the traction fund, which is growing out of the city's share of the profits of the surface railways, and to be leased to the four elevated railway companies on terms fixed in the ordinance.

The second ordinance provides for the system of subways recommended in the reports above reviewed, for the receipt of bids for the construction of these subways and for ordinances giving the successful bidder power to construct and operate these subways, and providing for city ownership at the end of the twenty-year franchise period.

Both these ordinances he proposes to submit to the voters at the city election in April, 1914, the one receiving the larger number of votes, in case both are approved, to be adopted. The agreement to lease under the first ordinance and the receipt of an acceptable bid under the second ordinance are necessary before the ordinances can be put to vote.

Equipments are to be furnished by the leasing elevated railway companies, including everything from the tracks up, the city to supply the bare tunnels. Arbitration of value on change of ownership to another company or the city is provided for; failure to operate road for three months works forfeiture to city of contract and equipment, except for fail-

ure of the tunnel itself, strikes and the like.

Five-cent fare with free transfer in the same general direction is required. The displaced elevated structures in and about the loop will be removed by the companies.

There is provision for change of routes if necessary and for extensions.

Specifications for construction and equipment are given in general terms. Provision is made for a board of control made up of two representatives of the company, two of the city, and a fifth selected jointly by the company and the mayor with the approval of the council, on failure of agreement, by the judges of the first district appellate court, or the circuit court as a last resort. This board has full control of all items of construction and operation as detailed in fourteen comprehensive items.

Bids are to be received on the basis of the annual percentage of the actual construction and equipment expenditures to be retained out of the gross receipts for interest, the percentage to be retained for sinking fund to amortize cost (except equipment) within the twenty years of the grant, and the proportions to go to the company and to the city of the profits remaining after paying operating expenses, taxes and insurance, the interest and the sinking fund charges.

A deposit of $1,000,000 in cash or equivalent approved securities is provided for as security for carrying out agreements.

Provision is made for transfer of ownership to city or another company at any time after ten years and of a method of determining the valuation at date of transfer, also for forfeiture on defaults.

The latter ordinance seems to have taken advantage, in both acceptance of good features and rejection or modification of objectionable features, of the experience gained by New York in its subway contracts and by Chicago in its street railway agreements, and promises to provide a way to secure the desired subways and their extensions, if the ordinance following the receipt of bids under its provisions is accepted by the people.

A City Beautiful Street

The illustration herewith shows Bernard street, Albany Park, Chicago. This street according to Mr. Adrian Molin, a Swedish expert on housing and living conditions is a "perfect avenue." Mr. Molin was sent on a world-wide inspection tour by the Swedish government, which is desirous of establishing perfect housing conditions for its people. "Bernard street," he declares, "is the finest street I have seen in America or in any other country. The points that entitle it to be thus designated are as follows: The location for one thing, is ideal, the highway perfect and the houses are architecturally satisfactory and better lighted, better heated and more sanitary than any others that I have found.

"The surroundings leave nothing to be desired and easy access to the city makes a home on that street possible to the man who works down town. The definite building lines give the street a formal attractiveness, but each house is an individual type."

While American housing experts will doubtless agree with the general idea expressed by Mr. Molin, our civic beauty experts can point to many instances in American cities of the use of the same ideas to appreciably better effect, because the details are much more carefully and artistically designed. Lamp posts, setting of trees, style of houses and their location, and even the entrance gateposts, are better worked out, whether purposely or accidentally, in certain Detroit streets of the same general design and with residences of the same or even cheaper class of construction.

BERNARD STREET, *Albany Park, Chicago, Ill., selected by a Swedish expert as a model street in all respects.*

Creosoted Wood Block Pavements In Springfield, Mass., and New Haven, Conn.

"Creosoted wood block pavements are giving universal satisfaction in this city, being used on both heavy and medium traffic streets," states Charles M. Slocum, City Engineer, city of Springfield, Mass.

"The regular practice for the last ten years is still followed, and long leaf yellow pine blocks treated with a compound of creosote oil and pitch are used. All work of this kind is laid on a 5-inch portland cement concrete base, and the joints filled with cement grout.

"The blocks were purchased of the United States Wood Preserving Company and the work of laying the entire pavement performed by the street department with the usual co-operation of the engineering department. This form of pavement, once which resulted in a more rapid rate of wear than would have been the case with ordinary blocks. The blocks used for relaying were furnished by the United States Wood Preserving Company without cost to the city according to terms of original guaranty.

"Aside from above instance, the cost of upkeep and maintenance on our wood block streets has been practically nothing. All of this work is done by day labor. All materials are purchased on competitive bids, under specifications, and contracts awarded by the city council. All the labor is hired through the city engineer's office. This method of doing work has been very satisfactory, and I think that we get better work for less money than under the contract system.

"Our streets paved with creosoted wood block total 59,613 square yards or 12,080 lineal feet as follows:

Street.	Length in Feet.	Area in Sq. Yds.	Year laid.
Bridge, Dwight to Chestnut	122	446	1910
Chestnut, Linden to Everett	419	1,438	1909
King, Street Railway turnout	317	1,023	1908
Main, Williams to Bliss	1,150	6,460	1906
Main, State to Worthington	1,899	10,798	1904
Main, Worthington to Hampden, w. side	382	1,183	1904
Main, Worthington to Hampden, e. side		962	1903
Main, Hampden to Lyman	153	775	1903
Main, Lyman to Liberty	484	2,780	1903
Main, Liberty to Sharon, e. side	453	1,135	1903
Main, Liberty to Sharon, w. side		1,487	1907
Main, Sharon to near Franklin and Emery	509	3,103	1907
N. Main, Morgan to Bancroft	879	4,544	1909
N. Main, Bancroft to Calhoun	839	4,210	1910
N. Main, Calhoun to Grove	673	3,466	1911
State, Main St. westerly	598	2,357	1909
State, Main to Dwight	478	2,403	1908
State, Oak to Stebbing	762	3,031	1909
State, Pleasant to Terrence	386	1,497	1910
State, Terrence to Westminster	639	3,256	1911
Worthington, Broadway to Water	299	1,061	1909
Worthington, Sackett Place	265	886	1908
Worthington, Federal to Armory	374	1,312	1908

regarded by some experts as more or less of a luxury in view of attending cost, is still regarded by the public and business interests as the most satisfactory material used in this city, possessing reasonable durability and general good qualities.

"The first entire replacement of wood block paving, due to ordinary wear, was made during the year; the blocks in the section of Main street covered by the Boston & Albany railroad arch and approaches thereto, laid in 1900, having been replaced for several feet outside the rails of the street car tracks, where the wear was the greatest. These blocks as first laid were grooved at all transverse joints,

"The city of New Haven, Conn., has 45,210 square yards of creosoted wood block paving," states Frederick L. Ford, City Engineer. "This type of pavements which was laid in answer to the question, 'why not lay a pavement that does not have to be repaired,' is giving excellent satisfaction. When a community arrives at that stage of the game, it is ready for creosoted wood block paving on its heavy and medium traffic streets and it usually gets it.

"It is the marvelous durability of creosoted wood blocks that has been the greatest factor in bringing about its remarkable success. In ten years' time under

heavy, or even moderate traffic, almost any other pavement is gone completely, after undergoing endless repairs. In ten years' time a creosoted wood block pavement is just at its best. It shows practically no sign of wear, is in as perfect a condition as when first laid, is smooth, noiseless and apparently good for at least another ten years of satisfactory service.

"There are several things necessary to properly construct a creosoted wood block pavement:

1. The proper kind and quality of wood.
2. The proper kind and quality of oil.
3. The proper amount of oil and treatment.
4. The blocks must be laid properly.
5. The joints must be filled properly.
6. The pavement must be cared for properly after construction.

"It is desirable that wood block be paved into the street as soon after treatment as possible. For this reason, it is well to have the concrete laid before the blocks are received and thus be able to deliver them directly to the pavers. In case this is impossible, the blocks should be tight-piled along the line of the work and they should be protected from the sun by wet straw, tarred paper or similar means and sprinkled with water from time to time to keep them from drying out too much. In piling blocks alongside of the street, it is desirable to make the piles as high as convenient, for they will occupy less sidewalk area and interfere less with pedestrian and delivery traffic.

"In paving, care should be taken to keep the courses straight and at right angles to the curb. Special attention should be given to paving around manhole heads, street car tracks and other iron work. Blocks should be paved against a vertical surface; to get this it is necessary with rails and may be necessary with other iron work to plaster the abutting face with a rich mixture of sand and cement. It is absolutely necessary adjacent to all such iron work that the cushion be specially tamped and thickened so that the block when paved shall be from 3/16 to ¼ inch above wearing surface of the iron. Traffic will bed these blocks down to level of the iron in a short time.

The following tabulation shows the streets in New Haven paved with creosoted wood block:

1908. Three-inch blocks on mortar bed.	Yardage.	Length in Feet.	Price per Sq. Yd.
Meadow, Congress to Water	5,043	1,242	$3.25
State, Grand to Chapel	4,054	901	3.25
Court, State to Church	2,123	825	3.25
Center, Orange to Temple	1,702	740	3.25
Church, Chapel to George	4,135	875	3.25
1910. Three and one-half-inch blocks on sand cushion.			
Congress, Howard to Lafayette	6,358	1,240	3.38
State, Chapel to Water	5,125	1,295	3.33
1911. Four-inch blocks on old foundation on sand cushion.			
Wooster, East to Olive	9,811	2,748	2.75
Three and one-half-inch blocks on old foundation on sand cushion.			
Church, Chapel to Elm	4,279	866	2.53
1913. Three and one-half-inch blocks on sand cushion.			
College, George to Chapel	3,840	850	3.34
College, Chapel to Grove	7,940	1,870	3.16
Congress, Howard to Davenport	16,830	3,570	3.16
George, College to Broad	482	200	3.16
Sachem, Prospect to Winchester	1,900	590	3.16
River and South Front, Ferry, easterly	1,960	340	3.16
Norton, Chapel to Derby	2,620	510	3.16
Union, State to Water	10,000	1,500	done by R.R.
Meadow, Union to Water	1,240	260	done by R.R.

All blocks are of long leaf yellow pine, except that about 850 square yards are of short leaf on southerly end of College street, because of steeper grade. Sand grouting used in all cases. As yet all pavements are under guarantee but there has been no appreciable maintenance expense.

Pavement Methods and Costs

By H. N. Ruttan, City Engineer, Winnipeg, Manitoba, Canada.

When the owners of property on any street desire a pavement or boulevard, or when the property owners in any locality desire the opening, widening, extension or diversion of any street, application is made to the city engineer for a form of petition to the council for the work or improvement. When such petition is signed by one-half in number of the owners representing one-half in value of the property to be benefitted by the work or improvement, the council proceeds therewith and assesses the cost against the property benefitted.

If in the opinion of the council any such improvement is necessary, and in public interest, it may direct that it be proceeded with on the city initiative, unless the property owners interested representing sixty per cent. of the value of the property petition against the proposed work or improvement within a month after the council gives notice of its intention to proceed with such work.

The assessments of the cost of the pavement improvements are spread over the following terms, viz.:

Asphalt No. 1 pavements.....15 years
Asphalt No. 2 pavements.....10 years
Macadam pavements ..... 7 years
Cedar block pavements ..... 7 years
Gravel pavements ..... 5 years
Boulevards ..... 7 years

The properties benefitted pay the entire cost of boulevards. In the case of macadam pavements 24 feet wide, the city at large contributes one-half the cost, and in cases of other classes of pavements of 24 feet or more in width, the city contributes a share of the cost equal to the cost of 12 feet of macadam pavement, and the balance is assessed upon the properties fronting upon the street whereon the improvement is made. When a street is repaved, the city having contributed to the cost of the first pavement, the properties benefitted pay the whole cost.

The following tables show the approximate annual cost of the various classes of improvements:

Cost of Local Improvements.

Description of work.	Width feet.	Terms of Ass'mt	City's share.	Approx. cost per front foot, cents per annum.
Asphalt No. 1 pavement.....	24	15 yrs.	1/5	40¼
Asphalt No. 1 pavement (Full width)	46	15 yrs.	1/10	79½
Asphalt No. 1 pavement (With double street car track)...	46	15 yrs.		58½
Asphalt No. 2 pavement.....	24	10 yrs.	1/3	20½
Macadam pavement	24	7 yrs.	½	20¼
Cedar block pavement.....	24	7 yrs.	2/5	30
Gravel pavement	24	5 yrs.		9
Boulevard (construction)	12	7 yrs.		4
Boulevard (maintenance)	12	annual		3½

Comparative Cost of Pavements—Cents per Square Yard.

Description of pavement	Grading	Ballast	Base	Binder	Surface	Total
Heavy asphalt No. 1 (6-in. concrete base).....	15	20	$1.20	45	85	$2.85
Liquid asphalt, No. 1 (4½-in. concrete base).....	15	20	.90	45	85	2.55
Asphalt No. 2 Base 9-in. crushed stone).....	15		.80		55	1.50
Creosoted wood block (1½-in. concrete base).....	15	20	.90		$2.00	3.25
Creosoted wood block (6-in. concrete base).....	15	20	1.20		2.00	3.55
Macadam						.90
Cedar Block	15	20	.50		.65	1.50
Gravel pavement (24 ft.).....						.35

Our municipal asphalt plant was installed in 1899 and is used for repairs, resurfacing and new work. There are two units, a stationary one with nominal capacity of 2,500 square yards of pavement (2-inch surface and 1½-inch binder) and a portable one with nominal ca-

pacity of 1,500 square yards of 2-inch surface per day.

Surface batch consists of 1,216 pounds of sand, 240 pounds of dust, and 175 pounds of asphaltic cement and will lay 8.5 square yards per batch.

Binder batch consists of 900 pounds of stone, 50 pounds of asphaltic cement, and will lay 6.5 square yards per batch. Cost of labor and material at works per square yard of pavement is as follows:

Binder and surface	$ 1.03
Cost of haul (average 1½ miles)	.10
Cost of street work	.10
Overhead cost	.10
Total cost per sq. yd	$ 1.29

Unit cost of materials—

Broken stone, per cu. yd	$ 1.75
Sand, per cu. yd	1.10
Asphaltic cement, per ton	21.64
Limestone, per cu. yd	1.15

Unit cost of labor, per hour—

Rakers and tampers	$0.35-$0.40
Asphalt plant labor	.25- .30
Common labor	.25

We are operating two Lutz surface heating machines in our asphalt resurfacing and maintenance work. By this means, the bumps or high places are softened and scraped off, leaving a clean surface of the old material. Such burning should be continued until the burned area will require at least 1 inch of added material to restore the pavement to its proper surface and cross-section. In almost every case, it is well to cut a joint at the edge of the burned area, 1 inch or 1½ inches deep, so that the edge of the old pavement may serve as a shoulder for the new material.

This operation is effective, simple and considerably less expensive than the old method. The surface heater is placed over the defective pavement and immediately put in operation. Super-hot air is then brought in contact with the surface and is allowed to remain there until the pavement has been softened to the required depth, usually from ¾ inch to 1 inch. The heater is then withdrawn and placed on the next spot to be repaired and the softened material completely removed. The space thus left is immediately filled with new hot surface mixture, which is spread, raked and finished in the usual manner. Care must be taken to completely remove all burnt material down to such a depth that the new surface, after compression, will not be less than ¾ inch in thickness, except in a very limited number of cases. Skin patching of less depth than this has not proven satisfactory. In order that repairs made by this method will give satisfactory service, it is essential that the remainder of the old pavement which serves as a foundation should be sound and in good condition and free from water rotting. It is not applicable to the class of repairs rendered necessary by defective binder or foundation, or water or gas rotting. When it becomes necessary to re-surface, wholly or in part, a pavement which has become too hard thru age to give satisfactory service, the surface heater method gives very good results, and is much cheaper than a complete removal of the old pavement down to the concrete. By applying the hot new surface mixture to the remaining portion of the old pavement while the latter is still hot from the action of the heater, a satisfactory union between the old and new work can readily be obtained, provided that the hardening of the pavement has not been allowed to proceed so far that it is impossible to soften it by the application of heat. Cracks may in most cases be more successfully repaired by this method than is possible in any other way. The repairing of cracks satisfactorily is a very difficult matter. If they are cut out and new material put in, this results in the formation of two joints approximately parallel to the original crack. If the pavement being repaired is old and hard, it is difficult to establish a good bond between the old and new portion and unless that is accomplished two cracks will shortly appear where only one existed before. This is especially the case where long cracks make their appearance at considerable intervals, and in many instances these had better be left until they become sufficiently wide and numerous to render more or less extensive resurfacing necessary at these places where they occur.

Concrete Roads in Indiana

The concrete road is spreading into Indiana. The county commissioners of Greene county are finishing a mile of 18-foot road; bids were received on November 15 for 4½ miles in and near Richmond, by the Wayne county commissioners, part on a boulevard 36 and 24 feet wide and part a country road 18 feet wide: and the county commissioners of Hamilton county have decided to build a half mile next year as a first trial of this material in that county.

Road Work in Texas

Since January 1 various counties in Texas have voted bond issues for good roads amounting to $5,295,000 and other counties have voted down projects amounting to $3,630,000. In November and December some twenty counties vote on bond issues amounting to nearly $6,000,000, most of which will doubtless

pass. This activity equals that of any other state in the Union, and is in many counties so well directed that it will result in good and economical construction.

American Road Builders' Convention.

The tenth convention of the American Road Builders' Association will be held in the First Regiment Armory, Philadelphia, Pa., Dec. 9, 10, 11 and 12.

Organization of road departments is the subject of Tuesday afternoon and Wednesday morning, with papers by the state highway commissioners of New Jersey and New Hampshire, a road contractor and the state geologist of North Carolina, on the duties and powers of highway officials, the division of expense, responsibility and authority between nation, state, county and township, the relations of contractor, engineer and inspector, and the practical handling of convict labor.

Wednesday, Thursday and a part of Friday morning are devoted to construction problems discussed by state highway engineers and officials of Pennsylvania, Arkansas, South Carolina, Minnesota, county and city highway engineers of Washington, Chicago, Cleveland, Brooklyn, New York, and contractors and testing engineers, covering reconstruction, selection of paving material and each of the common road materials, including earth, sand-clay, gravel, waterbound macadam, bituminous macadam and concrete, concrete, brick, wood and asphalt block, sheet asphalt, and granite block, the testing of materials and methods of letting contracts.

Friday closes the sessions with consideration of maintenance problems by New York, and Massachusetts State highway commissioners and engineers and Philadelphia's highway bureau chief, including organization of maintenance force, methods of repair and renewal, bituminous surface treatment and dust prevention.

All papers are to be discussed by men of equal prominence in the field of road construction and maintenance.

The program is exceedingly practical and correspondingly valuable to all interested in the problems of road building and maintenance and well worth the time and expense necessary to attend the convention. E. L. Powers, secretary, 150 Nassau St., New York.

Tennessee Water Power for Municipal and Manufacturing Purposes

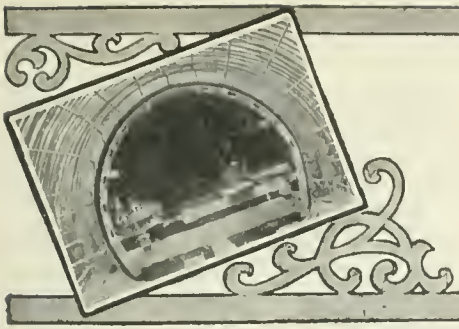
The second hydro-electric plant of the Tennessee Power Company, on the Ocoee river, in the Appalachian mountains of southeastern Tennessee, near Parksville, which was put in operation October 23, marks an important step in the industrial development of that part of the south. This plant, together with the other, seven miles away, on the same river, will ultimately produce a total of 68,000-h.p. The power is transmitted to Knoxville, Chattanooga and Nashville, Tenn., and to Rome, Ga. The length of the transmission line to Nashville is 150 miles.

The total cost of these two power developments on the Ocoee, which are practically two units of the same plant, was about $5,000,000. Both were constructed by the J. G. White Engineering Corporation of New York. The one which is just completed took fifteen months to build. In the former the chief feature of the work is a gigantic dam of concrete. In the latter it is an open flume nearly five miles long, by which the flow of water is carried along the mountainside. At the end of its journey it passes thru steel penstocks, dropping 250 feet to the turbines. These are of the pressure type, and each has a capacity of 10,000-h.p. The transmission line is built for 120,000 volts, but is operated at present at 66,000 volts. The generators are direct-connected to transformers which step the current up to that voltage.

A considerable part of the electrical energy of these plants is used in lighting the various cities along the line and in running their trolley cars. The total urban population supplied is about 250,000.

Much of the 20,000-h.p. of the new plant will be used near Knoxville in the manufacture of aluminum. Large deposits of alumina are found in this region, but it has not been possible heretofore to develop them adequately owing to an insufficient supply of electricity. The clay from which aluminum is produced is treated in electric furnaces, and is subjected to an intense heat that can be obtained in no other way. The plant of the Aluminum Company of America, near Knoxville, is one of the largest in the world.

The future possibilities of water-power development in Eastern Tennessee and the adjacent parts of North Carolina and Georgia are tremendous. Four large rivers traverse this region, the Tennessee, French Broad, Hiwassee and Cumberland. The utilization of these streams for the production of electrical energy is still comparatively in its infancy, but already Chattanooga, Knoxville and Nashville, and other smaller places along the line, are beginning to take on the appearance of New England manufacturing towns. The opening of this new power supply will give an added industrial impetus to this rich region.



SANITATION

Sewage Disposal for Pasadena, Cal.

The city of Pasadena, in connection with its immediate neighbors, South Pasadena and Alhambra, has formed a commission with a member from each corporation and the city attorney, to work out the details of a plan for a joint outfall sewer for the three. It has been thought necessary to carry the outfall sewer to the ocean, a project which would cost perhaps a million dollars, but the Sewage and Garbage Power Company, of which C. D. Crouch is the executive officer, has offered to take the combined sewage of the three municipalities at a point a short distance below the point of junction of their sewers and to purify and dispose of it without nuisance and in a manner satisfactory to the commission. The purified water will be sold for irrigation purposes and the sludge will be converted into fertilizer in commercial quantities. The same company made a bid for the disposal of the garbage of the city of Los Angeles which is now under favorable consideration.

Pasadena is now operating a sewage farm, and, while there have been complaints of it as insanitary and doubts of the sanitary condition of the products of the farm, it is pronounced by the engineer of the state board of health to be the model plant of the forty such establishments there are in the state. It would be abandoned if the Crouch system is adopted by the commission.

The nature of the Crouch process is not disclosed in the reports of the commission upon the subject.

Flood Protection Reports

Both Columbus and Dayton, O., have preliminary reports upon methods of flood protection, that of Columbus to serve as a basis for voting upon a bond issue for beginning the work and that of Dayton to show the general conclusions which can be drawn at this time. Neither goes into sufficient detail to make it possible to decide which is unquestionably the best plan, or, within a considerable percentage what the cost will be.

The various projects proposed by Alvord and Burdick for Columbus range in estimated cost from $10,000,000 to $23,000,000. Those costing over $15,000,000 provide for the passage of 200,000 cubic feet a second, which is 60,000 cubic feet more than the flow in the flood of March, 1913, which was 3.52 times the average flood. One costing about $13,000,000 provides for reservoirs on the upper watersheds of the two streams, part of the cost of which should be paid by the state and other counties and cities. Several projects, costing from 10 to 12 million provide for a flow of 150,000 cubic feet a second, ample for the March flood. For the larger flow, reservoirs are cheaper than stream improvement alone. For the smaller flow, stream improvement alone is the cheaper. One of these projects, costing $11,263,000 is recommended as the best, all things considered. It requires no reservoir.

The Morgan Engineering Co., in their report concerning Dayton go into the problem of the entire drainage area of the streams under consideration, in accordance with their instructions. They also present a number of methods of flood control. Seven of them provide local protection works, with reservoirs on a tributary stream as auxiliaries in two cases. The eighth plan provides for six reservoirs on the watersheds and would provide relief for all of the municipalities and counties involved, whereas those providing only for relief for Dayton would make conditions even worse for cities below. This eighth plan, which may cost about $12,000,000 is likely to be recommended, and aparently certain to be recommended if the proper co-operation of other cities interested can be obtained.

The plans providing for local protection are roughly estimated to cost 7 to 10 million, and the Dayton share of the reservoir plan would probably not be more.

At present, therefore, one city is best served with reservoirs on the headwaters of the streams and the other is best served by a plan without them.

The Ohio Valley Flood

The causes which led to the great flood in the Ohio Valley last spring, the losses therefrom, and the prevention of damage by future floods are discussed in the timely report just issued by the United States Geological Survey as the result of a field investigation of the districts affected and a study of the records of precipitation, run-off, and stream flow. While the flood of 1913 was the most destructive that has ever visited the Ohio Valley, it is pointed out that floods of the Ohio are now the rule rather than the exception and that the problem of preventing flood damage is a vital one, pressing for solution. In no year since 1873 has Ohio river failed to overflow its banks at some point along its course and flood large areas, and in some years the flooding has been repeated five times. The actual material loss on account of the recent flood is more than $200,000,000, without considering indirect losses or the loss of life.

A distinction is made between the prevention of floods and the prevention of damage by floods in order to bring out forcibly the obvious idea that excessive rainfall and the accumulation of excessively large volumes of surface water in river basins can not be prevented, but that the thing to strive for is to prevent the great damage done by flood water all along the river's course.

The report emphasizes the inadequacy of the data available concerning the Ohio river system and urges the necessity for an immediate broadening of the past and present meager studies of the conduct of the many great tributaries of the Ohio.

The report is published as Water-Supply Paper 334 and was prepared by A. H. Horton and H. J. Jackson. It includes a large number of records of stream flow and former floods, as well as illustrations of the flood of 1913. Copies may be had on application to the Director, United States Geological Survey, Washington, D. C.

Recoverable Values of Municipal Refuse

By George H. Norton, Deputy Engineer Commissioner, Department of Public Works, Buffalo, New York.

The choice of method of disposal of refuse between immediate and complete destruction by fire and that of partial utilization of available portions must rest upon two factors: sanitary advantage of immediate destruction and commercial returns from utilization. When these two factors are known, then decision can be intelligently made between sanitary desirability and its attendant expense. If the public health can be better served by the determined extra cost of immediate destruction than by means of the same investment along other lines of health service, then destruction must be adopted.

That in the consideration of this subject there may be available reliable data on recoverable values of certain municipal wastes, the following facts are submitted from the experience of Buffalo, N. Y. The collection of wastes are divided into three classes:

Domestic garbage;
Coal ashes;
Refuse, being all other domestic wastes.

The refuse consists of paper, tin cans, bottles, old furniture, with some metal, rags, rubber, etc.

Collection is made by contract and the refuse delivered by the contractor at the municipal plant, situated one mile from the center of the city. This plant was originally constructed by a previous contractor on city property, was subsequently acquired by the city, remodeled and now consists of two 40-ton Heenan-Froude furnaces, fed from storage bins by a conveyor belt. Access by teams is over an elevated roadway, where wagons dump into storage bins, the refuse being drawn from their bottoms onto a conveyor belt, which passes up an incline thru a picking and sorting room, where recoveries are made, and the remaining refuse is passed to the furnace. Each furnace has a 120-h.p. water-tube boiler placed over it. The steam generated is used to operate and light the plant and to operate sewage pumps in an adjoining building. In figures here given, credit is given the refuse plant at 70 cents per hour for steam furnished the sewage pumping plant. Pickers or assorters are stationed on each side of the elevated belt, each recovering some designated material. Waste paper is assorted into various grades, depending on market demands, thrown into iron bins, and on the floor below is pressed into bales. Tin cans are placed in storage bins and thence spouted into cars. The ash, clinker and non-combustible material are hauled to dumps.

Since July 1, 1912, all delivery to plant is weighed and record made of cubic contents of wagons. The table shows the records by months for the year July 1, 1912, to June 30, 1913, as taken from the monthly statements, and may vary slightly from official consolidations when made.

	Paper baled								
	News	Mixed	Manilla	Flour Bags	Charcoal Bags	Rags	Tin Cans	Total Weight	No. Bottles
1912—									
July	189.466	325.132	25.345	0.175	0.135	10.530	25.725	576.508	19.290
Aug.	136.060	374.677	20.160	0.175	0.225	6.885	16.450	554.632	12.845
Sept.	162.193	339.137	23.810			7.025	8.750	540.915	12.005
Oct.	206.490	364.136	27.040	0.436	0.282	7.275	16.500	622.159	13.060
Nov.	158.062	287.435	24.282	0.357	0.255	5.772	18.900	495.064	19.366
Dec.	155.823	290.367	27.282	0.400	0.190	6.185	33.050	513.298	18.371
1913—									
Jan.	181.579	321.897	28.025	0.455	0.410	7.592	35.300	275.259	17.381
Feb.	135.324	249.102	26.277	0.465	0.350	5.760	34.500	451.689	14.019
Mar.	147.840	325.897	28.942			5.097	53.950	562.037	12.150
April	178.335	401.937	28.407	0.490	0.277	6.490	45.050	660.987	21.143
May	264.645	460.617	40.972			6.040	35.925	808.200	10.925
June	226.350	400.890	28.310			3.810	32.050	659.360	23.830
	2,142.167	4,141.134	328.852	2.952	2.124	79.271	325.650	7,020.108	194.385

	Material Received			Sent to Dump.	
	No. of Loads	Cu. Yds.	Weight.	Furnace Residum.	Non-combustible.
1912—					
July	1,329	22,316.8	1,482.5	215.9	32.615
August	1,279	20,986.8	1,395.4	200.9	30.698
September	1,129	21,161.3	1,407.0	207.2	30.954
October	1,300	25,924.4	1,723.7	264.3	37.921
November	951	18,936.9	1,259.1	181.7	27.700
December	1,100	21,182.3	1,408.4	214.0	30.984
1913—					
January	1,256	24,969.4	1,660.2	259.9	36.524
February	1,095	18,628.5	1,238.6	188.2	27.249
March	1,164	22,538.9	1,498.6	224.4	32.969
April	1,272	28,363.9	1,885.9	293.2	41.487
May	1,612	34,613.6	2,301.4	359.3	50.630
June	1,486	19,883.4	1,986.9	318.0	43.711
	14,973	289,506.2	19,247.7	2,927.0	423.444

From this the following deductions are drawn:

Average load of refuse, cubic yards.19.3
Average weight of load, tons..... 1.29
Average weight per cu. yd., tons... 0.066
Average refuse per year per inhabitant (445,000 pop.), tons..... 0.043
Per cent. of total weight recovered.37.0
Per cent. of total weight non-combustible 2.2
Per cent. of total weight furnace residuum 15.5
Per cent. of total weight burned in furnace 45.3
Sale value per ton refuse received, exclusive of steam value..... $2.12
Sale value per ton refuse received, inclusive of steam value..... $2.36
Labor cost per ton refuse received. $1.78
Labor cost per ton refuse recovered $4.80

In the above, weight of bottles at one pound each has been added to recovered weights and $1,000 added to pay roll for proportion of superintendent's salary.

During this year reconstruction and rearrangement of the plant have been under way and a part of the labor charge might well have been charged to construction account. For one week the plant was shut down for such alterations. It should also be stated that the plant is practically complete for the incineration of garbage with the refuse, entailing extra construction costs.

Financial Summary.

Sale of recoveries	$40,877.29	
Steam sold	4,565.58	
Total receipts		$45,442.87
Pay rolls	$33,160.85	
Part salary of supt.	1,000.00	
Maintenance and repairing	3,523.07	
Residuum to dumps	1,872.00	
Operating expenses.		$39,555.92
Net profit from operation		$ 5,886.95

No computation is here made of charges for interest, depreciation and insurance, but the same may be inferred from the following:

Valuation of plant	$135,000.00
Valuation of land	25,000.00
Total valuation	$160,000.00

Not all of the available steam is utilized.

From the above it may be seen that disposal of refuse, with recovery of materials of value, may be made without material cost near the center of a large city, thus saving the cost of extra haulage to

unsightly dumps. Disposal by complete combustion could not thus be made unless arrangement for sale of steam in irregular supply were of an unusually favorable nature. This is done without the nuisance and without material complaints or injurious effects upon the health of those engaged in this work. This subject of effect upon health may well be the subject of further detailed investigation.

The production of heat is an incidental process in refuse destruction. After disposing of the refuse in a sanitary and inoffensive manner, the question of how best to utilize this heat then arises. The question is answered by combining a steam boiler with the furnace and producing steam at any desired pressure. Steam so produced is available for running engines to produce electricity, but, as a rule, the amount of electricity which could be produced is but a small proportion of the total amount which is consumed by the community; also, the operation of the destructor does not lend itself to the requirements of peak loads, which are incident to all lighting and power stations. A pumping load, however, is ideal for a destructor, because of its uniformity and constancy, and it is in this direction that a municipality has its greatest opportunity for conserving this energy.

In many respects the requirements and the working conditions of a destructor and of a pumping station are parallel, and they may briefly be summarized as follows:

They should both be centrally located. They are frequently best arranged in subdivisions to serve districts. They are a public service feature which requires constant, steady operation. They may be combined under one superintendent, calling, as they do, for the same kind of experience and knowledge. The same applies to the employes; they may be interchangeable, for the same reason. Similar articles of supply are needed at both. Both should be scrupulously clean and sanitary in all their features, also in the method of operation. An electric transporter and grab bucket are frequently used for transferring the refuse from a common receiving pit to feed hoppers of the destructor; the same apparatus is often required by water works for transferring coal, as received, to the storage hoppers. The facilities for disposing of ashes and clinker are also similar. Many economies may be effected to the municipality by the combination of these two equipments.

It would hardly be expected that the exact amount of steam available from the destructor would coincide with the exact amount of steam required at the pumping station, but the almost invariable condition is that the destructor steam is somewhat less than required by the pumps. Therefore, the difference is made up by auxiliary boilers.

It is evident that the steam may be passed direct from the destructor to the steam range of the pumping station, or it may be converted into electricity and used to drive motor pumps. Instances in this country where steam from a destructor is used directly for driving pumps are found at Montgomery, Ala.; Westmount, near Montreal, Quebec, and Savannah, Ga.; while instances where the power is first converted into electricity and then used to drive motor-driven pumps are found at Milwaukee, Wis., and Savannah, Ga.

Mr. T. W. Kennedy, deputy street commissioner, is in charge of this plant, but as this bureau has had charge of much of the construction work on the plant, Assistant Engineer Frank D. Jackson, of this bureau, is in close touch with the whole plant. Since July 18 the city has taken over the entire field plants for collections of garbage, ashes and refuse and for street cleaning, and is now doing all collection. The elapsed time has not been sufficient to give any data of value on such work, but the recovery value increased for July and August of this year about 27 per cent. over that of last year, due largely to better separation under city operation. A thoro trial has been made of garbage incineration with the 45.3 per cent. of combustible in the refuse, and no trouble is experienced in burning twenty tons of garbage per day in one furnace with this proportion of refuse, and without nuisance.

Commercial Relations of the United States

A concise volume, which contains statistics showing the foreign trade of each country of the world during 1911 compared with the previous year, has just been issued by the Bureau of Foreign and Domestic Commerce at Washington. This valuable publication shows the principal articles and their value entering into the trade of each country and the itemization of the imports from and exports to the United States. The statistics were prepared by American consular officers and supplemented by other official data. In addition to trade statistics, the grain crops and mineral output of the principal countries are given, thus presenting in compact form the principal features upon which the commerce and industries of the foreign countries depend. The volume should prove highly valuable for reference purposes, having been revised and brought up to date so far as statistics were available.

WATER

New Process for Purifying Drinking Waters

By Dr. Robert Grimshaw, Dresden, Germany.

THERE are plenty of summer residence towns and villages where nature has been most bountiful in all that appeals to the eye, but where either she has been ill-humored, or man has been more or less criminally careless in the matter of the drinking water. Fortunately, science comes to to our aid and enables us often to free otherwise undrinkable water from mechanical impurities, or eliminate or neutralize chemical constituents. Filtering, either on a large scale or in the household, and "doctoring" are the two methods employed. The most usual means of chemical purification is the employment of permanganate of potash; but this is really only effective when employed in comparatively large quantities. This subject is treated somewhat exhaustively by Georges Lambert, head apothecary of the French colonial troops, who has, of course, had abundant opportunity to judge the subject of unhealthful waters. According to him, all processes by which the water is colored only pale rose are not sufficient in their action on the microbes in the water, and especially on the typhus bacillus. It requires at least six centigrams of the permanganate per liter (3.51 grains per U. S. gallon) of water to produce satisfactory results; and the sterilizing is more thoro when a precipitate of manganic oxid is formed.

As a result of these observations, Lambert advises, for the clarification of small quantities of water, the following procedure: A mixture is made, consisting of 60 grams of potassium permanganate, 50 grams of manganese dioxide and 390 grams of pulverized talc; and of this mixture there is used half a gram per liter of water (29.2 grains per U. S. gallon), the quantity being readily measured by a spoon. For dirty, muddy or foul-smelling water, twice or three times as much of the mixture is used. After it has acted about ten minutes, there should be added to each liter of water two drops of a saturated solution of sodium hyposulphite, containing a trace of hyponitrite of bismuth. The water should be stirred quite lively for a minute or so, then the precipitate should be given time to settle; and next the water should be filtered, preferably thru regular filter paper. This process yields a clear, colorless, sterilized water, which may be drunk with pleasure. The same process is also suitable for application on a large scale. Lambert advises the following:

One employs two reservoirs of equal capacity. In one there should be added to every hundred liters of water 6 grams of potassium permanganate (3.51 grains per U. S. gallon), care being taken that it is fully dissolved. In the other reservoir there is added to each 100 liters of water 44 grams of a dry mixture of 50 grams of manganese dioxide and 390 grams of pulverized talc, added to the water in the proportion of 44 grams to 10 liters of the potash water (257 grains per U. S. gallon). After ten minutes there is added 6 grams of sodium hyposulphite, the water is stirred two minutes, then 50 liters (13.2 U. S. gallons) are added from the first reservoir and the whole is stirred three minutes. Then the rest of the water is added and the whole is stirred five minutes. In a half hour the water will be clear and sterillzed.

This process is cheap and simple, and has been employed with success by Europeans in the tropics.

Low Pressure in Minneapolis Water Works

A complaint of low pressure in the water works system of Minneapolis, Minn., on June 12 and 13, was investigated by the engineers of the commiteee on fire prevention of the National Board of Fire Underwriters who found that the conditions were no more serious than in 1910 and 1911 and that the water works officials are taking active steps to remedy the conditions causing the low pressures.

From May 21 to June 14 no rain had fallen, which resulted in large quantities of water being used for sprinkling. Toward the end of this period the consumption became greater than ever before known; for eight consecutive days beginning on June 9, the pumpage exceeded 40,000,000 gallons a day; on the 12th or 13th with the temperature several degrees above the normal, two units of the filter plant were out of service because of repairs. On the 14th there was a good fall of rain, repairs on the filters were completed and normal conditions were restored. The high rate of pumpage continued until the 16th, when 45,749,000 gallons were pumped, the maximum figure to date, but the presssures after the 13th were not excessively reduced.

An examination of the charts of the recording pressure gage in the water department office on the second floor of the city hall, elevation 165, shows a reduction in pressure on the 12th from 63 pounds at 3 a. m., to 30 pounds at 7:30 p. m., when sprinkling was most general; on the 13th the minimum was 22 pounds. The low pressure lasted from two to three hours. While pressures were lowest those at street level in the congested value district ranged from 30 to 45 pounds, which is satisfactory for engine supply. In residential districts situated on the higher levels little water could be drawn for domestic purposes above the first floor.

A $600,000 bond issue is being floated and work on improvements is already under way.

Four more rapid sand filter beds, each 28 by 51 feet, have been started, which added to the twelve at present in operation, will increase the capacity of the plant to 60,000,000 gallons a day.

The supply to the entire city has been made more reliable by the laying of a 54-inch lockbar steel force main from the pumping station to the sedimentation basin, and a 48-inch supply main from the clear water reservoir to Central avenue. The latter is to be extended south across the river. Contracts for pipe have already been let. Later on, this main will be extended south along Cedar avenue to 38th street, reducing gradually in size. Its effect will be to reduce greatly the excessive friction losses now occurring at times of high consumption, and to cause a marked increase in pressure thruout the east, central and south portions of the city.

The high ground in the vicinity of Kenwood boulevard is to be included in the Lowry Hill service, and the service supplied by a booster station, the foundation for which is completed and equipment contracted for. About 1,500 feet of 24-inch main is being laid around the broken 24-inch main north of Lowry Hill; this will give a large additional feeder to this part of the city.

The high ground in the vicinity of Prospect park is to be included in a separate high service with a booster station on University avenue near Arthur avenue. A water tank, 22½ feet in diameter and 56 feet high, capacity 165,000 gallons, with overflow at elevation 320, is to be located near Malcolm and Clarence avenues. The foundations for both the booster station and water tank are completed, and contracts let for equipment and steel work.

These improvements will materially strengthen the entire system and greatly increase both pressures and the quantities available for fire protection in the higher parts of the city. The recent low pressures were the result of unusual conditions, were no worse than have occurred in past years, and, with the completion of the improvement outlined above, are unlikely to be repeated.

Construction Features of Water Supply and Storage Works, City of La Crosse, Wis.

The following brief description contains interesting information relative to a few of the more noteworthy features and methods employed in the construction of the water storage and supply works at LaCrosse, Wis.

The well system consists of twenty wells, all of which are 10 inches in diameter. The maximum depth of well is 159 feet and the minimum depth 116 feet.

The twenty wells are arranged in five groups of four wells each. The wells in a group are always at least 100 feet apart. Each group of wells will be operated by a vertical electric-driven, DeLaval centrifugal pump of 1,400 gallons per minute capacity. These pumps will operate against a total head of 40 feet and will deliver water into the low service reservoir adjacent to the main pumping station. The well groups are spaced from 800 to 900 feet apart.

A reinforced concrete well house is

provided to house the pumping outfit at each group of wells. These houses are about 12 feet in diameter by 24 feet high, inside measurements. The suction and discharge lines at each well house are about 6 feet lower than the ground surface. The 15-inch floor of the house is 2 feet below these pipes.

The construction of these well houses is rendered somewhat difficult by the great amount of water present in the soil. A circular line of sheeting was first driven and the material excavated by hand tools. Water in the excavation was kept down by means of gasoline-driven Sta-Rite diaphragm pumps. When the excavation was down to grade a large tub was lowered into the excavation. The inside diameter of this tub was equal to the outside diameter of the well house. The top of the tub was at about the level of the ground surface. The tub was carefully centered and made water-tight by calking. After the tub was so placed and prepared the 15-inch concrete bottom of the house was poured upon the wooden bottom of the tub. This wooden bottom was, of course, left in place. The inside form was then carried up from the concrete floor in the usual way. The inside form was held in place by sets of circular curbing. Concrete for the well houses was elevated to the working platform by means of a horse and a 3-leg derrick of suitable height. To avoid possible future unequal settlement of the houses, the sheet piling was left in place.

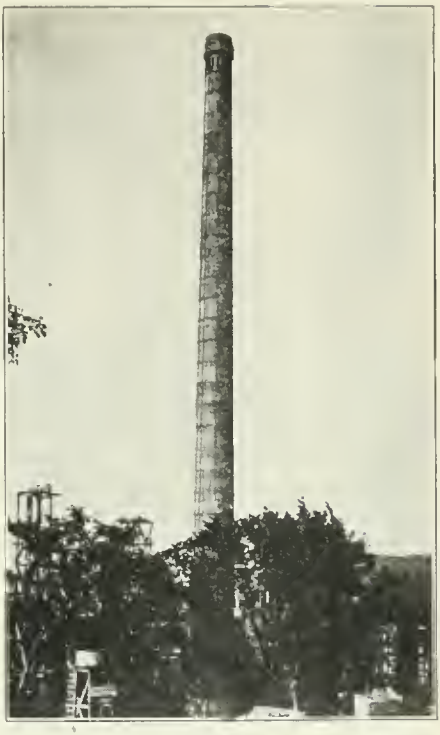
The suction lines are laid from the wells to the pump house with a slight rise to avoid the possible formation of air pockets in the line. These trenches were all sheeted with Wemlinger steel sheet piling and braced with extension trench boxes. This piling kept the sand and muck out of the trench effectually, but it was necessary to pump almost constantly with the small gasoline-driven diaphragm pumps or a Nye steam pump to keep the water out of the trenches. The ground was pretty thoroly saturated with water. The piling was all driven by hand, and these trenches were excavated by hand.

The pumping station is a fireproof structure. The foundation, floors and roof are of reinforced concrete, while the walls above the footings are of brick.

The low service reservoir of 1,000,000 gallons capacity is adjacent to the pumping station.

The high service reservoir is of 5,000,000 gallons capacity. It is located on the side of the Granddad bluff at an elevation to give a pressure of 90 pounds per square inch in the business district.

The chimney for this plant is built of reinforced concrete, being erected by the Weber Chimney Company, of Chicago. It is 157 feet high above the bottom of the foundation, 152 feet above grade and has



CONCRETE *chimney of La Crosse, Wis., Water Works.*

an inside diameter at the top of 5 feet. The outside diameter at the base is 10 feet, the foundation is 18 feet 6 inches square, greatest thickness is 4 feet. The reinforced concrete walls of the shaft are 4 inches thick at the top and 12 inches at the base. The shaft is reinforced vertically with sufficient steel to take up all tension due to bending moment, at least of 100 miles per hour wind, and also horizontally with rings at short intervals to take up all temperature stresses. Foundation reinforcement consists of two nets, the diagonal and rectangular net. Vertical bars in the shaft are extended into the foundation and bent in under the foundation reinforcement, securing a perfect anchorage.

The mixture of concrete in the foundation is of 1 part cement, 3 parts sand and 5 parts gravel; in the shaft, 1 part cement, 2½ parts sand and 4 parts gravel.

The forms used were in sections 4½ feet high, being the Weber patented unit form, and adjustable so as to give the proper taper to the stack. The stack is designed to withstand the pressure due to wind velocity of 100 miles per hour.

The engineers in charge of the work for the city of LaCrosse were J. W. Alvord and C. B. Burdick, of Chicago.

MISCELLANEOUS

The City Manager Plan of Municipal Government

The National Short Ballot Organization has issued a pamphlet on the city manager plan of municipal government which gives a brief history of the movement which began a few years ago in Staunton, Va., thru the appointment of a city manager by the city council, but was formulated as a regular plan for city government by the city of Lockport, N. Y. That city was not able to obtain legislative sanction for its plan but furnished the ground work for the new charters of the cities of Sumter, S. C., and Hickory and Morgantown, N. C. The home rule provision adopted in the new Ohio state constitution gave Dayton the opportunity to establish the city manager plan which will go into operation January 1, 1914. That city was followed by Springfield, and will probably be followed by Sandusky, while Elyria and Youngstown have rejected the modified plans proposed for them. An Ohio statute has been passed making it easy for any city to adopt one of the three standard plans of city government now in vogue, so that Ohio cities will doubtless fall into line in large numbers if Dayton is successful in the operation of the system. That Dayton will succeed is probable from the fact that the city is trying for the best talent it can find to fill the office of city manager. The position has been offered Col. Goethals, the head of the Panama Canal, and Mayor Hunt, of Cincinnati, who has made a conspicuous success in inaugurating a house cleaning in that city has also been seriously considered.

LaGrande, Ore., and Phoenix, Ariz., are western cities which have adopted the plan, and Whittier, Cal., Douglass, Ariz., and Waycross, Ga., voted against the plan. Little Falls and Brainerd, Minn., and Amarillo, Tex., hold elections too late to be reported upon at this time.

Richard S. Childs contributes to the pamphlet a discussion of the theory of the new controlled executive plan and C. G. Hoag one of the representative council plan, which is the city manager plan with proportional representation.

The articles of charters, adopted or proposed, covering the city manager are given for the Lockport plan, Sumter, Whittier, Hickory, the Ohio Statute, Dayton, Springfield, LaGrande, Phoenix, Douglas, Youngstown, Little Falls, and Waycross.

Franchises and Municipal Home Rule

The committee on franchises of the National Municipal League made a report to the Toronto convention of the National Municipal League which considers a number of questions concerning the source of control of public utilities which few have heretofore felt it worth while to ask. They are mainly as to the division of control of public service corporations between the city and the state.

The Wisconsin system has been taken by common consent to be upon the proper basis, the state controlling the financial relations of the companies and the municipal plants to the point of fixing rates subject to the modifications of existing contracts and agreements between cities and companies. This leaves to the city by contract or ordinance the control of the physical system and of the quality and quantity of service, subject to appeal to the state commission by either party if he considers himself aggrieved.

The working out of details in cases arising under the present laws, especially in states which have not followed the Wisconsin plan exactly, has brought about a number of discussions of the permissible amount of interference of the state authority with the principle of local control of local matters. In states where the principle of home rule of cities is not recognized this class of questions is most likely to arise.

The argument of the committee in favor of a maximum of local control is good and would limit the state control practically to that exercised under the Wisconsin plan, or even less, including capital and revenue control, publicity of accounts, determination of rates, and decisions on appeals concerning quantity and quality of service.

The difficult question of the extension of service, especially of street railway lines and pipe lines into new, undeveloped but rapidly developing territory is quite

fully considered and the propriety of assessing all or a part of the cost of such extensions on the property benefitted is fully discussed and favorably considered, due allowance being made, of course, in making up the company's capital account for such extensions. Such assessments are now made in a number of cities in making extensions of municipal plants and the committee evidently favors a similar treatment of extensions in privately owned plants, differing only in detail.

The members of the committee are evidently in favor of municipal ownership and desire to make the transition from private to municipal ownership as easy as possible. They advocate a maximum limit of duration of franchises so as to force readjustments and give opportunity for municipal purchase upon easier terms. Their course of reasoning is not easy to follow, even to one in favor of municipal ownership, and is not satisfactory to one who is disposed to favor controlled private ownership. The company under a limited franchise must be permitted to repay its outlays within the time limit if the city is to have an opportunity to purchase the plant at a price less than the appraised value for which it can be purchased under almost any regulation law in existence. But this only transfers the burden of payment, or a part of it at least, to the customers of the plant, making them pay higher rates all the time for the benefit of the city at large at the time the purchase is made. This is hardly logical.

It should not be difficult, even if it requires a constitutional amendment, to make bonds on the municipal plant a lien on the plant alone, perhaps with a guarantee of the interest by the city at large, and thus make it safe and easy to secure the money for making the purchase at even more favorable rates than the company was able to secure.

While the amortization of the capital of private companies is recommended, on the same principle that public plants are supposed to proceed, the effect of such amortization upon the purchase price of the business is not considered in the report. Here is an opportunity to render easier the purchase of the business by the city.

Perhaps it is just as well not to make it too easy for the city to purchase a well operated and well controlled private plant.

The resettlement of outstanding franchises, especially those styled perpetual, is considered in the report to some extent. The tendency to declare perpetual franchises void, in this respect at least, as contrary to public policy, is recognized in part, and the right of the company to full compensation for everything but what is strictly franchise value is also recognized. The effect of these two propositions in making easier the settlement of old forms of franchise and their replacement by the newer forms is shown and the desirability of this course of procedure is demonstrated.

In the states which make it attractive for public service utilities to give up franchises and come in under the indeterminate permit, the committee's report will have little of direct practical bearing.

Report of Investigation of Chicago Bureau of Streets

Reports on the investigations in the Chicago bureau of streets just completed by the Civil Service Commission in conjunction with the Department of Public Works have just been issued.

These reports are the culmination of nearly eighteen months' effort, starting with the efficiency division's investigation for a scientific basis for the ward appropriations for the year 1913, which was adopted by the city council for the 1913 budget.

Many of the recommendations in the joint report have already been installed under the direction of a technical board, consisting of members of the street bureau and the civil service commission. The adoption of the other recommendations included in the joint report and the supplementary report should give to Chicago scientific management in cleaning of streets and the collection and haul of garbage, refuse and other miscellaneous waste.

The salient features of the recommendations in these reports are:

1. Uniformity of service in all sections of the city in street cleaning, street repair and the collection and removal of city wastes, depending upon the conditions, methods and requirements.

2. Appropriations and expenditures based upon definite standards and units and measured service and the requirement of a standard day's work for every officer and employe.

3. Provision of municipally owned modern equipment for both street cleaning and street repair work and garbage and refuse hauling.

4. Provision of a comprehensive plan of loading stations and incinerating plants in different sections of the city to give the most economical haul and disposition of city wastes. The construction of a number of these is recommended for next year.

5. Absolute control of employment of laborers, teamsters and helpers by one city employment body.

6. Uniforming employes as a measure of efficiency and control and the prevention of injury and death.

The reports are exhaustive, accurate and useful and a credit to the city of Chicago.

Reward for Evidence of Grafting

On the back of every pay check issued by the city of Memphis, Tenn., appears in red ink the following offer:

$100.00 *REWARD.*

A reward of one hundred dollars will be paid by the City of Memphis to any person who can and will furnish proof that any city employe has been guilty of grafting, while holding such employment. The name of such informant will, in no case, be divulged.

The City Government pays good salaries and, in return, expects and insists upon good service, which it is now getting. Neither the Mayor or any City Comimssioner is aware of any grafting; however, there is talk the world over about graft in municipal work, and IF THERE ARE GRAFTERS CONNECTED WITH THE CITY OF MEMPHIS THE CITY COMMISSIONERS WOULD LIKE TO KNOW IT. THE OFFENDERS WILL NOT ONLY BE REMOVED FROM THE CITY PAY ROLLS BUT THEY WILL BE PROSECUTED TO THE FULL EXTENT OF THE LAW.

Kinkaid, Ill., the Latest Town Made to Order

The town of Kincaid, Ill., is a coal mining town built by Francis S. Peabody, the owner of much coal land in Christian county, as the residence and business center for the coal mining industry which he has developed and will develop in the vicinity. The town is 6 miles west of Taylorville and has its own railroad running from Auburn on the west to Taylorville on the east; connecting with four main lines.

Samuel Insull, the electrical center of Chicago, is interested with Mr. Peabody in producing an electric town. A power house is located a half mile out of town at a coal mine, and the electricity there generated will supply this and other towns and cities for many miles around with light, power, and heat, thus reducing the smoke nuisance to a minimum as well as conserving the coal supply.

The original town site will cover about 400 acres and will have accommodations for 6,000 people. The west end of town is flat and the plat shows rectangular blocks, but the center and east end are on ground dipping sharply to the flat bottom lands of the south fork of the Sangamon river. Here the streets conform to the contour of the ground and are more irregular in line and location, but not so much so as to be confusing. This gives an opportunity for the landscape architect to locate public buildings, parks, gardens and boulevards to the best effect. One feature of the east end is the public gardens in the creek bottoms. Each miner who wishes will be assigned, free of charge, a small plot on which to raise vegetables and small farm products. In this district is also a tract called the meadows to be used for recreation purposes. Along the edge of the town are small park and farm tracts which can be used for suburban residences and by miners with farming proclivities. The location of small parks is one of the successful features of the town. A nursery for starting shade trees was started some time ago and the landscape architect, Mr. Maclenberg has supervised the placing of the trees along the streets and in the yards surrounding the houses.

Alvord and Burdick, of Chicago, have charge of the planning and construction of the town on the engineering side and have worked in harmony with the landscape architect and the architect of the public buildings.

During the past summer they have superintended the construction of about 6 miles of sewers and 100,000 cubic yards of excavation in the grading of streets. The length of the streets graded to date totals about 7 miles. A contract has recently been let for 200,000 square feet of sidewalks which it is hoped to have completed during this working season. No street paving will be done until next spring, in order to give the sewer trenches a maximum length of time in which to settle.

The street paving in the downtown district will be brick on concrete base and in the residence section will be macadam. The streets in the downtown district are 80 feet in width with a 40-foot roadway and two 20-foot sidewalks. The slope from curb line to street line is a uniform incline of 6 inches in 20 feet. The residential streets are 60 and 66 feet in width, having a roadway 24 feet in width. The slope from the curb to the property line is the same as for the business district, that is 6 inches in 20 feet.

The sidewalks on residential streets are from 5 to 8 feet in width and slope toward the curb the same amount as the parkway. All sidewalks are set 1 foot from property line. Sidewalks are laid as follows: Four inches of cinders thoroly compacted, upon which is placed 1:2:4 concrete base $4\frac{1}{2}$ inches in thickness. This is covered with a top dressing $\frac{3}{4}$-inch thick, mixed in the proportion of one part cement to $1\frac{1}{2}$ parts sand. The surface is trowelled smooth.

The street names are placed in the sidewalks at the curb lines. A board 6 inches in width and the length necessary

to accommodate the name of the street is imbedded in the finish coat as it is applied. This board is later removed and the space filled with a white mortar in which are imprinted with a stencil the letters of the street name. The stencil is then removed and the imprint of the letters filled with a colored mortar.

Sanitary sewers are to be provided thruout the town, but storm water sewers will be needed in the business portion only, as the streets are so laid out that they will carry the surface drainage away rapidly.

The source of water supply is now being investigated and complete water works will be installed during this winter and the early spring of 1914.

Contracts for Chicago Harbor Improvements

On September 15 last, there were opened, in the offices of the Harbor & Subway Commission, sealed proposals in accordance with plans and specifications for Pier No. 2 in Harbor District No. 1, Chicago, Ill.

There were three proposals, each accompanied by a certified check for $30,000, in conformity with instructions to bidders, from the following:

Byrne Brothers Dredging & Engineering Company.

Great Lakes Dredge & Dock Company.

Fitz Simons & Connell Dredging & Dock Company.

A letter of proposal was received and read from John Monk & Sons, New York City, offering to do the work for 4½ per cent. of pay rolls and material bills to be paid by the city. As this last mentioned offer was not in accordance with specifications, nor guaranteed by the required deposit, it was not considered.

Following the opening of proposals, the commissioners proceeded to canvass the same, and to tabulate the prices submitted.

It was found that the lowest bidder, both as to prices and to time of completion, was the Byrne Brothers Dredging & Engineering Company.

Before the awarding of the contract, in accordance with this finding, became possible, a temporary court injunction, in the name of a taxpayer, was obtained and served on the Harbor & Subway Commission.

The court proceedings were referred to a Master in Chancery for the taking of evidence regarding the specifications, and while the latter was in progress, the thirty-day limit in which, according to specifications, the contract should be awarded, lapsed.

On October 27 last, the Harbor & Subway Commission held a formal meeting and rejected all the proposals heretofore received for contract work on the substructure of Pier No. 2, in Harbor District No. 1.

This action was preceded by letters from the Great Lakes Dredge & Dock Company and the Byrne Brothers Dredging & Engineering Company, withdrawing their respective proposals.

The Harbor & Subway Commission is now preparing specifications, and will readvertise for proposals covering the same contract work outlined as above.

Personal Notes

Walter H. Flood, recently chief chemist of the Chicago municipal asphalt plant and engineering chemist of the bureau of engineering, has opened an office at 613 Bonheur building, Chicago, Ill., as a chemical engineer, paying special attention to tests, inspection and specifications for engineering structures and particularly for paving and paving and road materials, the industrial application of bituminous products and the analysis of food products.

W. S. Harvey has been promoted to the position of city engineer of Lethbridge, Alberta, where he has been assistant in charge of water works and sewers for the past two years.

A. C. D. Blanchard has resigned his position as city engineer of Lethbridge, Alberta, to become an engineer on the Greater Winnipeg water district.

The appointment of Frank A. Kattman as city engineeer of Terre Haute, Ind., is announced to take effect January 5, 1914. Mr. Kattman is now city engineer and superintendent of water works in Brazil, Ind., and a senator in the Indiana legislature.

F. H. Burnette has opened an office at 716 Traction Terminal building, Indianapolis, Ind., for practice as a contracting engineer in the design and construction of concrete and framed structures, steam and electric railways, water and steam power plants, water supply, irrigation and drainage.

Technical Schools

The non-resident lecturers in the graduate course in highway engineering at Columbia University, appointed for the 1913-1914 session, are as follows: John A. Bensel, New York state engineer; William H. Connell, chief of bureau of highways and street cleaning, Philadelphia; C. A. Crane, secretary of the General Contractors' Association; W. W. Crosby, chief engineer, Maryland geological and economic survey, and consulting engineer; Charles Henry Davis, president of the National Highways Association; John H.

Delaney, commissioner of the New York state department of efficiency and economy; A. W. Dow, chemical and consulting paving engineer; H. W. Durham, chief engineer of highways, borough of Manhattan, New York City; C. N. Forrest, chief chemist of New York Testing Laboratory; Walter H. Fulweiler, chief chemist of United Gas Improvement Company; Frank B. Gilbreth, consulting engineer; George P. Hemstreet, superintendent of the Hastings Pavement Company; Samuel Hill, president of the American Road Builders' Association; D. L. Hough, president of the United Engineering and Contracting Company; J. W. Howard, consulting engineer; Arthur N. Johnson, state highway engineer of Illinois; William H. Kershaw, manager of the paving and roads division of the Texas Company; Nelson P. Lewis, chief engineer of the board of estimate and apportionment, New York City; Harold Parker, first vice president of the Hassam Paving Company; Paul D. Sargent, chief engineer of the Maine state highway commission; Philip P. Sharples, chief chemist of the Barrett Manufacturing Company; Francis P. Smith, chemical and consulting paving engineer; Albert Sommer, consulting chemist; George W. Tillson, consulting engineer to the president of the borough of Brooklyn, New York City. Registration for the courses in highway engineering begins December 1.

The University of Illinois, on November 1, had registered 1,178 undergraduate students in the College of Engineering, mechanical engineering heading the list with 270, followed in order by electrical and civil engineering, architecture, architectural engineering, and at a long distance by mining, railway and municipal and sanitary engineering, the latter with 26 students.

Technical Associations

At the meeting of the New York Electrical Society, held November 20, Bassett Jones gave a lecture on the lighting of colored and ornamental surfaces in artistic harmony with the design of architectural interiors, illustrated by lantern, a color and shadow booth, minature stage lighting, etc., which was entertaining as well as instructive.

The dual subway system in its relation to the rapid transit history of New York was discussed by LeRoy T. Harkness, assistant counsel for the public service commission, at the meeting of the Municipal Engineers of the City of New York, held November 26. The annual dinner of the society will be held at the Savoy, January 10, 1914. An inspection of the New York connecting railroad was made November 1, and one of the Kensico dam was made in company with the Brooklyn Engineers' Club on November 15.

The International Engineering Congress, in connection with the Panama-Pacific International Exhibition at San Francisco, will be held September 20 to 25, 1915. W. A. Cattell, secretary, Foxcroft building, San Francisco, Cal., will send information.

But one cement show will be held in 1914, at Chicago, beginning February 14, and practically all the exhibit space is taken. Seven associations more or less closely connected with the cement trade will hold conventions during the show, including the American Concrete Institute, the National Builders' Supply Association and a number of local organizations.

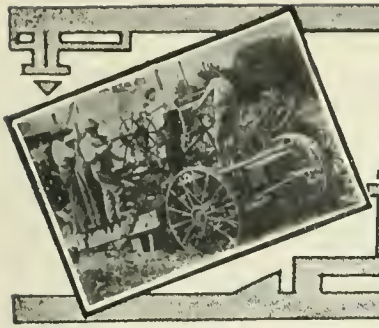
W. W. Brush presented a paper to the Brooklyn Engineers' Club at its November meeting, on the effect of water waste prevention work on extension and operation of the Brooklyn water supply system.

The exhibition of American and foreign city planning at the Public Library in New York City is in progress, November 24 to December 6, and is an interesting and instructive exposition of ideas of civic beauty accomplished and in prospect.

The papers presented at the November meeting of the New England Water Works Association were by Caleb Mills Saville, on cleaning water mains in Hartford, Conn., and by Lawrence J. Henderson, on water and life. There was also a discussion of the advisability of securing legislation for making water bills a lien upon property suppplied.

There has been formed in the city of Chicago and vicinity an organization composed of men following the engineeering profession, for the purpose of finding ways and means for the advancement of engineers' salaries and standardizing of positions. The organization is affiliated with the American Federation of Labor, and further details may be had upon application to the secretary, Louis A. Heyn, 32 North Fifth avenue, Chicago, Ill.

The National Municipal League held a successful convention, styled the Twenty-first National Conference for Good City Government, at Toronto, November 11-15, under the presidency of Wm. D. Foulke. The report of the committee on franchises is considered elsewhere. Another live question presented was the city manager plan by the committee on the commission form of government, Richard S. Childs, chairman. Our leading article this month is by Mr. Bradford, who opened the discussion and states fully his views. Municipal budgets, civic education, liquor legislation, municipal court, methods of voting, scientific public works management, were other subjects well handled in committee reports and papers.



MACHINERY AND SUPPLIES

Kissel Kars in Water Works Departments

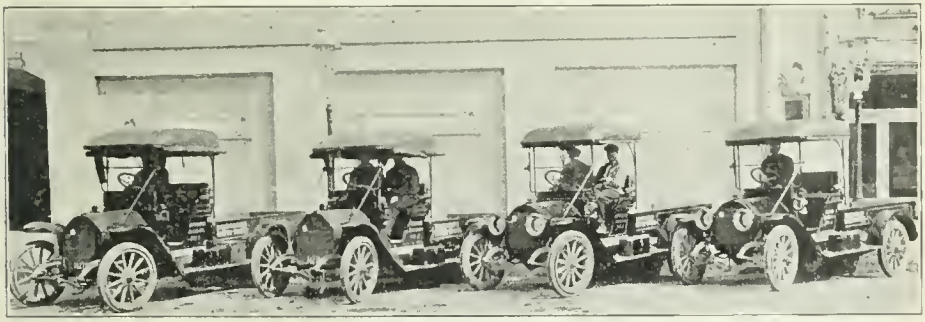
"For the Los Angeles water works, the motor vehicle has made possible the centralization of authority, equipment, men and supplies," writes Burt A. Heinly, of the city water works department, Los Angeles, Cal. "The city today extends over a wide area and the limits continue to broaden. With the continued use of the horse, it would have been necessary to establish three sub-stations in widely separated parts of the city with all the attendant expense of grounds and buildings, additional clerks and the duplication of equipment, stock and records. This, in fact, was under contemplation several years ago. The city has increased greatly in area since that time.

"Despite the growth of the past decade, a trebling of population, the organization retains the compactness of a small system. Every man who has executive authority comes into direct contact with the chief engineer or the assistant superintendent at the beginning of each work day. If there are problems, they are threshed out then and there. There is no sitting down on the job to wait until the boss comes around.

"Moreover, by means of his runabout, the assistant superintendent is able to visit and personally inspect the work of every pipe laying gang, once in the morning and once in the afternoon, an average day's run of about 70 miles. The same may be said of the chief engineer, the chief mechanical engineer and the service superintendent.

"The centralization of the work, the efficiency in the handling of complaints of all descriptions and the betterment of the work by the personal equation of the superior who is in daily contact with it, are benefits that are not reducible to dollars and cents. We are very thoroly of the belief, however, that compared with these things the saving in labor and horse hire, figured at $1,300 per month, will take second place.

"The horse has been relegated to the rear in the case of breaks, leaks, meter readings, turn-offs and turn-ons and complaints of all kinds. Now, a foreman with his automobile and gang connects his portable telephone with the nearest line and reports to the central office as soon as he has finished a job. He is then directed to the job nearest at hand. The complainant is often surprised to find that altho he may live 10 miles from the water works office, 10 or 15 minutes after he has telephoned his grievance to headquarters there is a department man at the door to help him out of his difficulty. This sort of efficiency is the kind that begets confidence on the part of the con-



FLEET *of Kissell-Kars in use by the Water Department of Milwaukee, Wis.*

sumer and the whole-souled co-operation of the entire city.

"Two 29-h.p. Kissel Kars of 1,500-lb. capacity each are used in the meter repairing division. These cars carry four men and replace six horses. The horses in our stables cost us an average of $225 per head. After six years of service on our asphalt streets a horse has served his purpose and we are glad to part with him for $50. Harness and wagons cost the department an average of $150 per outfit. It is our belief that the department has the right to expect 15 years' service from a well-built, first-class car. This would make the annual depreciation amount to only 6.66 per cent."

"This department is operating four Kissel Kar trucks with such success that it is the intention of the department to dispense gradually with all horses and wagons," states Henry P. Bohmann, superintendent of water works, Milwaukee, Wis.

"Practical demonstration and a tabulated record of work done by horse teams convinced us that it would be beneficial to replace horse teams with auto trucks.

"The following tabulation shows the work done by 4 teams for 5½ days. It shows the number of jobs attended to, the actual time used in teaming to the jobs and return and the actual working time spent in taking off or setting meters.

One Week's Work With Four Tteams.

Team work and tlme—

	Jobs	Hrs.	Min.	Hrs.	Min.
Setting new meters..	117	20	39	23	5
Taking off old meters.	124	19	21	22	50
Taking off old meters.	145	16	46	25	16
Resetting old meters.	157	18	6	28	53
Total	543	74	52	100	124

"These figures were taken at the time when we were very busy and had a good many meters to take off for repairs and reset, thereby making it possible to route the work very closely. It can be said to show the maximum work that can be done under the best conditions, as figures show an average daily setting of 24½ meters per team. Ordinarily, when work is normal the average would not be more than 10 to 20 per day. It will be seen that 42 per cent. of the time was spent in driving the teams to the jobs and back to the shop; 57 per cent. of the time was left to work in. When one realizes that 42 per cent. was spent in teaming under the best condition, it can be seen that a good percentage of teaming time can be cut down by using a motor truck, thereby increasing the actual working hours considerably, which will result in higher daily average of meters set. In our case we find that a motor truck can set or take off 36 meters per day.

"In using teams, we had the city divided into ten districts, while by using two motor trucks, we were able to cut the city into four districts. The work does not have to wait until it can be closely routed as was the case when using horses, as the trucks cover a far greater territory."

Destruction of Garbage on Premises

By B. C. Allen, C. E., Chicago, Ill.

No municipality can afford to devote the whole of its attention to what it can get from the garbage can from a commercial point of view.

The problem should be viewed from a sanitary standpoint first of all.

The most sanitary way to dispose of raw garbage is to promptly destroy it by incineration on the spot, and for this reason it is very probable that the majority of our municipalities will eventually require that all owners of residences attend to this matter themselves.

The majority of present ordinances require owners of apartment buildings of six apartments or more to dispose of their own garbage. It is very likely, however, that these ordinances will in the near future not only require that owners of apartment buildings of three apartments or more dispose of their own garbage, but that they will specify that the garbage be disposed of by incineration in approved burners, on the premises. There is a definite tendency in this direction at this time.

The prompt incineration of garbage on the premises where it originates not only means more sanitary alleys, back yards and basement passageways, but a great financial saving to the municipality. It is not likely that the average residence or apartment owner would take exception to such a plan as the incineration of raw garbage on the premises where it originates, and the problem of furnishing hot water for household use is closely related.

Following are the results of tests recently made on Kewanee water heating garbage burners on the cost of burning garbage in two apartment buildings in Chicago:

Test No. 1.

Building: Three-story apartment, 5541 East End avenue, Chicago, six apartments, two bathrooms each.

Installation: One No. 32 (Type A) Kewanee water heating garbage burner.

Period of time, 72 hrs.

Total amount of coal used, 276 lbs.

Total cost of coal, 58 cts.

Tot. amount water furnished, 1,962 gals.

Av. temp. of water used, 160 deg.
Raised from av. temp. of 36 deg.
Garbage burned, 4.1 bu.
Used Pocahontas coal, cost $4.20 ton.
Cost of coal per apt., 24 hrs., 3.2 cts.
Cost of burning garbage and supplying water, each dept. 24 hrs., 3.2 cts.

Test No. 2.

Building: Three-story apartment, 4165 Ellis avenue, Chicago, nine apartments.
Installation: One No. 36 (Type D) Kewanee water heating garbage burner.
Period of time, 168 hrs.
Total amount coal used, 1,400 lbs.
Total cost of coal, $2.94.
Tot. amount water furnished, 7,630 gals.
Av. temp. water furnished, 143 deg.
Raised from a temp. of 36 deg.
Garbage burned, 22.4 bu.
Used Pocahontas coal, cost, $4.20 ton.
Cost coal per apt., 24 hrs., 4.66 cts.
Cost of burning garbage and supplying water, each apt., 24 hrs., 4.66 cts.

Other tests will be found on p. 404 of the October number.

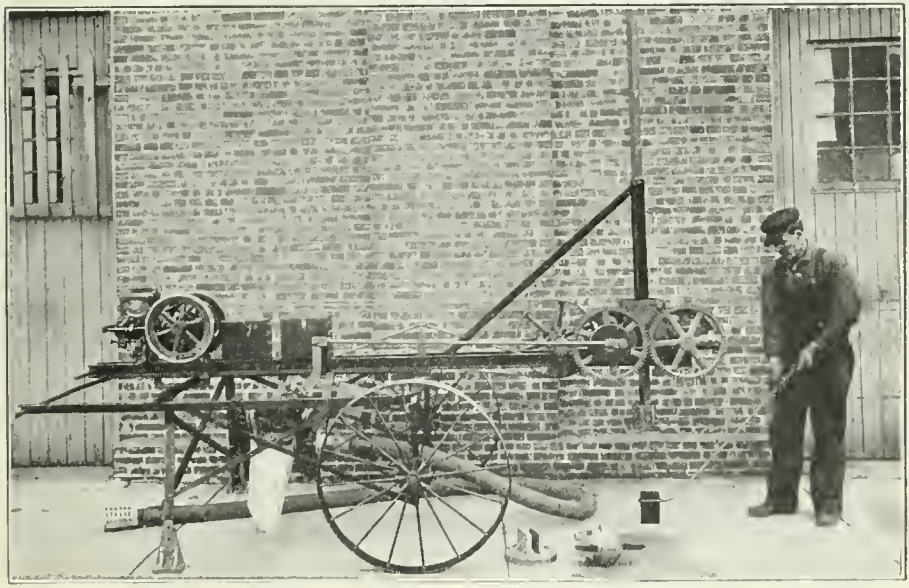
Use of Small Power Tamper

By H. L. Strange, Manager Honolulu Gas Company, Ltd., Honolulu, Hawaii.

For some time we have been mechanically tamping back-fill in trenches at a considerable saving in cost over hand methods. Our experience justifies the statement that this method is also most effective, as our machine, going over the same ground which has been hand tamped, will further depress the surface from 2 to 3 inches.

We use this machine, which is known as the Staley power tamper, in all but exceptionally rocky ground and find that two laborers can tamp with it from 1,200 to 1,500 square feet per hour. All earth taken out is put back, and even after the heavy rains no settlement appears. While one man can handle the machine on small trenches and surface work, where the footing is good, on trenches that are wide or where the footing is soft, it will pay to have two laborers handle the machine, putting one man on each side of the machine, where they will be in the best position to keep it moving along the work and sweep across. The power machine with two men to handle it should do as much work as from eight to ten men using the hand tampers, as the power machine will not shorten the stroke or reduce the number per minute, for this is automatically regulated, and the operator can give his whole attention to moving the machine over the work.

The machine consists of a truck carried by two 36-inch wheels (and supported at the rear by legs), upon which is a long frame or sweep which is pivoted over the truck axle and is composed of a pair of 3-inch steel channels stiffened by truss rods. It is swung to and fro horizontally to cover desired width. This frame carries a small gasoline engine at one end, while at the forward is a train of gearing which gives a vertical reciprocating motion to a long bar or timber fitted with a tamping head. The wheels



STALEY *tamper with attachment for cutting holes in concrete walks.*

and the shoes on the rear legs have a vertical adjustment of about 8 inches, so that the machine can be set level when working close to the curb, with one wheel and shoe on the sidewalk.

The vertical beam or lifter bar is hardwood, faced on two sides with small steel channels which slide in the channel guides supported by diagonal braces from the frame. The lifting mechanism consists of two rolls placed on opposite sides of the lifter bar, geared together and driven from the engine by a belt. The front roll is pressed against the tamper by coiled springs, and a portion of the circumference of each roll is cut away so as to release the tamper automatically. Thus the tamper is gripped, raised and dropped once with each revolution of the rolls, the length of stroke being 2 feet. The number of strokes is from 50 to 60 per minute. When not in use, the tamper is held in the raised position by a pair of dogs or grips attached to the guides and held against the bar by springs. When it is desired to stop the tamper (while the engine is running), these dogs are released and thrown into action and they then prevent the tamper from dropping at each revolution of the rolls; the rolls will then raise it to the full length of its travel, but as the size of the tamper bar is reduced near the bottom, the rolls lose their contact with the bar which then remains held in the raised position by the dogs.

A Roller and Scarifier Combined—A Correction

On p. 85 of the July number of MUNICIPAL ENGINEERING is an article entitled "A Roller and Scarifier Combined," which indicates by quotation marks that it is all quoted from F. E. Ellis, manager of the Essex Trap Rock and Construction Co., Peabody, Mass. In fact, the quotation should include only the first two paragraphs, Mr. Ellis not having written the last four paragraphs of the article.

A Manual of Standard Wood Construction

The Yellow Pine Manufacturers' Association, Geo. K. Smith, secretary, Wright building, St. Louis, Mo., have issued the fourth edition of their booklet for engineers, architects and builders, containing useful information and tables appertaining to the use of yellow pine. The good things of the former editions have been retained, some of them rearranged and reclassified to make them more convenient, and a number of new tables have been added.

Southern yellow pine is the timber considered, exclusively.

Properties of beams, mill and laminated floors, columns, joist construction, stud partitions, shingles; safe loads for beams, plain and trussed, uniformly distributed, limited by resistance to horizontal shear along the neutral axis; maximum bending moments for beams and floors; maximum spans and deflections for plank and laminated floors; safe spans and total loads for joists; formulae for flexure of beams; physical properties of yellow pine, holding power of nails and spikes; specifications of various organizations covering uses of yellow pine, grading rules, standard sizes of shiplap and heavy flooring, are the subjects treated in great detail, with full tables covering all commercial sizes of timber.

The book is in very convenient pocket book form, with clear type and well-arranged tables. It will be sent on request of engineers and contractors on firm letterhead, the price to the general public being 50 cents.

Street Paving in El Paso, Tex.

The grand jury recently in session in El Paso, Tex., made a report on street paving laid and still under guarauty, the result of investigation by its committee of the complaints made.

Mundy West Boulevard in part, Magriffin avenue, and Montana, altho only 1 year old, are recommended for rebuilding. Repairs are called for on Wyoming, Rio Grande and Alameda streets and on East Boulevard, near the rails of the street railway company. The jury says that there are numerous other streets in El Paso where minor repairs will improve them, but the above named are the most important. They find also that there are many excellent pavements in El Paso that have been used for traffic for from 1 to 7 years, where no repairs have ever been needed, and today they are in excellent condition, and therefore, recommend that the authorities allow only such paving put down as will stand the traffic, and also that where built by contract and the contractors made bond for their maintenance and delivery to the city in perfect condition, the necessary repairs and all rebuilding be done at the contractor's expense.

About two years ago, in an effort to secure something cheap for light travelled streets, several kinds of bituminous construction were tried, using oil and asphalt applied by sprinkling, by the penetration process, and mixing method, and with various kinds of machinery. Work of these cheap kinds is included in the streets complained of above.

The type of pavement in most general

use on the main streets of the city is bitulithic of which there has been laid approximately 535,332 square yards, which are now in their first to eighth year in age. But one street of this material is mentioned by the grand jury, and in this case, that of East Boulevard, the defects were entirely confined to the block pavement along the rails of the street railway tracks.

Cost of Motor Truck Hauling on Catskill Aqueduct Tunnel, New York

"We have made great headway by the use of motor trucks," states L. C. Brink, General Supt., Pittsburgh Contracting Co. "We have found no work which could have been profitably done with

MAIN STREET, *Memphis, Tenn., equippepd with new ornamental lighting system.*

New White Way in Memphis, Tenn.

The new Main street lighting system of Memphis, Tenn., is composed of 326 ornamental iron standards, each supporting five high-power tungsten lights. One 100-watt light on each standard burns all night, while four 60-watt lights burn only until midnight. The accompanying illustration shows but a part of the new Main street lighting system, which extends over a distance of 2¼ miles. The lamps were installed upon the front-foot assessment plan; that is, the owners of abutting property paid for the standards and for installation, on a front-foot basis, and the city maintains the light, supplying the current and keeping the standards painted and in good condition. The city has been given full title to the lamps. The standards are placed 70 feet apart. They were manufactured by the Casey-Hedges Company, of Chattanooga, Tenn.

wagons. We have saved from 20 to 25 per cent. at least, on the cost of disposal, by their use. There will undoubtedly be a great saving in the delivery of materials when we begin concreting.

Among the factors making for the efficiency of the motor truck are that it has a considerably greater carrying capacity and higher speed than the horse-drawn equipment, and taking into account the motor truck's capacity, it requires less time for loading and unloading a given amount of material. It can be operated continually and its maintenance cost when not in service amounts to very little.

In June, 1911, we started work on the construction of that portion of the New York aqueduct extending from shaft No. 6, at the Aqueduct road and McCombs road, Bronx, to shaft No. 12, at 106th street, and Central Park West, Manhattan, a distance of 28,200 feet. We also

have another contract from the city to fill in a portion of the Hudson river water-front between 116th and 129th streets. The New York Central Railroad freight tracks run close to the water's edge at this point. The dump will be slightly over a half mile long and will vary in width from 100 to 200 feet.

All of the rock received from shafts Nos. 6, 7 and 8 is crushed and stored for use in concrete work, and will be distributed to the other shafts for the same purpose. Shafts Nos. 9, 10, 11 and 12 are situated in a very populous section of the city, which makes the building of large rock piles impractical. So all of the dirt, rock and material included in the term "muck," which comes from these shafts, is carried in our motor trucks to the Hudson river dump.

The majority of the motor trucks used by us on this work are equipped with heavy platform bodies, built to receive a dump bucket which has a capacity of 4 cubic yards. The stone is brought up from the tunnel in dump cars, of 2 cubic yards capacity, and dumped into a huge tipple, equipped with dropping chutes and operated by chain blocks. The capacity of each of these tipples is 140 cubic yards. The rock is chuted from the tipple into the dumping bucket carried by the truck, and when the truck reaches the dump an electrically operated swinging derrick picks up the bucket, carries it out to the proper point, dumps it, and replaces it on the platform body of the truck. Two of our trucks, however, are equipped with Shadbolt roller dumping bodies, operated by hand. These are loaded in the usual manner at the tipple and dump their contents without the aid of the derrick. They work slightly ahead of the derrick, and prepare the foundation for it.

That the motor truck performs work impossible for the horse, is best illustrated by the record of one of our Garford trucks, which traveled 1,592 miles in one month's time, as follows:

Day of Month.	Total Mileage.	Round Trip.
February 20	82	19
February 21	93	23
February 22	96	24
February 23	22	9
February 24	26	9
February 25	46	16
February 26	81	23
February 27	65	22
February 28	39	12
March 5	84	32
March 6	80	32
March 7	72	23
March 8	68	25
March 9	23	9
March 10	77	25
March 11	65	26
March 12	68	27
March 13	82	29
March 14	76	30
March 15	38	15
March 16		
March 17	42	14
March 18	86	32
March 19	81	30
26 days	1,592	535

Demonstration 6½-Ton Truck From Shafts 9, 10, 11 and 12, to 129th Street Pier, Sept. 8, 1911.

	Time.	Time elapsed Min. Sec.	Cyclometer reading.	Distance miles.
Left Shaft 9	12:57	11:30	428.7	
Arrived 129th St	1:08:30		430.6	
				1.9
Left 129th St	1:10			
Arrived Shaft 9	1:21:31	11:30		
Left Shaft 10	1:01:15			
Arrived 129th St	1:08:30	7:15		
Left 129th St	1:10		430.6	
Arrived Shaft 10	1:17:15	7:15	431.9	
				1.3
Left Shaft 11	1:47		435.9	
Arrived 129th St	1:52:30	5:30	436.8	
				0.9
Left 129th St	1:54			
Arrived Shaft 11	1:59:45	5:45		
Left Shaft 12	1:42		435.0	
Arrived 129th St	1:52:30	10:30	435.0	
				1.8
Left 129th St	1:54			
Arrived Shaft 12	2:05	11:00		

Observatory Road, Cincinnati, Ohio. Constructed with "Tarvia X"

Cincinnati's Experience with Tarvia

CINCINNATI began building roads with Tarvia in 1907, when part of Madison Road, the main eastern thoroughfare from the city, was resurfaced with it.

The results were so satisfactory that the tarviated area was extended year by year, and the road has been in such good condition that it was selected for exhibition at the Road Makers Convention in 1912. During these six years the maintenance cost had been trifling, consisting of slight repairs and partial treatments with "Tarvia B."

Erie Avenue, an extension of Madison Road, was resurfaced with "Tarvia X" in 1908. Before that it had required resurfacing every six months. After the Tarvia treatment no maintenance was required until 1912, when some repairs were made and a surface treatment of "Tarvia B" was given.

Grandin Road was tarviated in 1907, and since then has had one surface treatment with "Tarvia B" and other slight repairs.

Burnett Avenue was tarviated in 1908. Two years later it received a surface treatment of "Tarvia B" and is in first-class shape now.

Observatory Road was tarviated in 1909 and was not touched for repairs until 1912, when it received a surface treatment of "Tarvia B" at trifling expense.

All these are important and busy thoroughfares which had a serious maintenance problem before Tarvia was used.

Tarvia is made in three grades—"Tarvia X" is a dense, viscid coal tar product of great bonding power, suitable for building macadam roads; "Tarvia A" and "Tarvia B" are thinner grades suitable for roads already in use to preserve them and make them dustless.

Booklets on Request.

BARRETT MANUFACTURING COMPANY

TRADE B MARK

New York Chicago Philadelphia Boston St. Louis Kansas City Cleveland
Cincinnati Minneapolis Pittsburgh Seattle Birmingham
The Paterson Mfg. Co., Ltd.—Montreal Toronto, Winnipeg, Vancouver, St. John, Halifax, Sydney, N. S.

Contract 65 calls for about 2,500 lineal feet of shaft, 310,000 cubic yards of rock excavation in tunnel and about 120,000 cubic yards of concrete lining in tunnel. The rock excavated is raised to the surface in mining cages and dumped into elevated wooden bins at each head frame. From each bin there are three outlets in the form of inclined chutes, under which are suspended 4-cubic yard skip buckets, which are filled by opening gates in the chutes. A Garford truck, to the rear of which a trailer is attached, is then driven under the skip and the latter is lowered upon the wooden frame work of the truck, which is designed especially to carry detachable skips. The capacity of the trucks is 6½ tons each, so that with the trailers 13 tons of material are taken away each trip. On arriving at the dump at 129th street and the Hudson river, the skips will be lifted off the trucks by derricks and their contents dumped into the river.

The majority of our trucks, which are Garfords, furnished by the Willys-Overland Co., Toledo, are worked on three shifts each day, which means 22½ hours. The first shift goes on at 8 a. m., the second at 4 p. m., and the third at 12 o'clock, midnight. One-half hour is allowed the men for meals, and at that time gasoline and oil are supplied, and a hurried inspection is made by the garage mechanics. Careful inspection three times a day has resulted in keeping the trucks in excellent condition.

That the speed of the motor truck, as compared with horse-drawn wagons, is a very profitable factor from the contractor's standpoint, can best be illustrated by the following record obtained from two separate trips on one of our 6-ton Garfords which was equipped with a platform body and a 4-cubic yard dumping bucket:

First Trip.

Clock Time.

Left the dump after unloading...10:07
Arrived shaft No. 10, a distance of 1¼ miles 10:17
Received a full load from tipple and left the shaft 10.21
Arrived at dump 10:31
Derrick removed bucket, dumped and returned same to the truck at 10:33½

Second Trip.

Left the dump after unloading..10:33½
Arrived shaft No. 10, 1¼ miles...10:43
Waited for another truck to load until 10.46
Received full load from tipple and left 10:52½
Arrived at dump 11:01
Waited one minute for another truck to be unloaded 11:02
Backed up in position, and derrick unloaded the bucket, truck leaving the dump at 11:04½

Remarks. First Trip.

Running time for 1¼ miles...10 Mins.
Loading time ..... 4 Mins.
Running time for 1¼ miles, loaded .....10 Mins.
Unloading time ..... 2½ Mins.

Remarks. Second Trip.

Running time for 1¼ miles... 9½ Mins.
Lost time waiting for another truck to load..... 3 Mins.
Loading time .....4½ Mins.
Running time for 1¼ miles loaded .....10½ Mins.
Lost time waiting ..... 1 Min.
Unloading time ..... 2½ Mins.

The above two trips may be summed up, in brief, as follows:

Operation.	First trip.	Second trip.
Distance from dump to shaft.....	1¼ miles	1¼ miles
Running time, empty	10 minutes	9½ minutes
Running time, loaded	10 minutes	10½ minutes
Time required to load	4 minutes	4½ minutes
Time required to unload	2½ minutes	2½ minutes
Lost time, due to waits	None	4 minutes
Load carried	4 cu. yds. stone	4 cu. yds.
Time for round trip, 2½ miles.....	26½ minutes	31 minutes

Weather, fair. Streets, good condition, paved with cobble and asphalt. No heavy grades. Plank road over dump. Condition of machine, excellent.

The following table gives in detail the operation of one of our 6-ton Garford trucks from July 25th to Nov. 30th:

Days operated	106
Total miles	3,997
Number of trips	420
Average miles per day (including time car stood idle).....	37.7
Average miles per trip.....	9.5
Total hours operated	1,021
Average time per trip (24 min. each trip loading), hours.....	2.4
Total weight (tons net).....	2,302
Average tons carried per trip.....	5.5
Total gasoline consumed (gal.)...	1,504

WHAT ARE THE PARTICULAR ADVANTAGES OF THE

Knox-Martin Tractor for Fire Department Work?

The Knox-Martin Tractor is a three-wheeled motor vehicle which can be coupled to any horse type of truck at the fifth wheel by means of an ordinary king pin.

It thus saves good horse-drawn equipment by affording a practical and economical means of motorizing it.

The Knox-Martin Tractor is supported on very flexible springs independent of the load, through which the driving re-action is absorbed, thereby relieving the motor and transmission from sudden starting and stopping strains.

The single wheel in front gives a large steering radius and makes manipulation of long pieces of apparatus easier through crowded traffic or backing into the engine house.

The Knox-Martin Tractor works on the correct principle of drawing the load rather than pushing it.

It has ample power to pull the heaviest apparatus up grades which could not be negotiated by horses.

All vital parts of the mechanism are readily accessible, facilitating prompt repairs.

Two or more Knox-Martin Tractors can be purchased for the price of one piece of motor-driven apparatus.

Send for more complete information and prices.

KNOX AUTOMOBILE COMPANY

SPRINGFIELD, MASS.

New York Branch, 1872 Broadway. **Chicago Branch, 1458 Michigan Avenue.**
Boston Branch, 885 Boylston Street.

Gasoline per mile (gal.)	0.37
Gasoline per mile (cost)	$0.041
Gasoline per net ton, cost	$0.072
Oil consumed (gal.)	146
Oil per mile (gal.)	0.036
Oil per mile, cost	$0.013
Oil per net ton, cost	0.018
Cost, driver per mile	0.12
Cost, driver per ton (net)	0.21
Cost of carting—	
5.5 tons, 1 mile	0.34
1 ton, 9.5 miles	0.58
1 ton, 9.3 miles	0.657
1 cu. yd. sand, 9.5 miles	0.75
1 cu. yd. gravel, 9:5 miles	0.87
1 cu. yd. stone, 9.5 miles	0.78
1 cu. yd. sand, 1 mile	0.079
1 cu. yd. gravel, 1 mile	0.09
1 cu. yd. stone, 1 mile	0.082

We are operating thirteen motor trucks, the majority being Garfords, furnished by the Willys-Overland Co., of Toledo, O. The bodies on our trucks are hung between the side springs, thus permitting a low loading platform, a feature always to be commended in heavy contracting work. Four-speed transmission provides a speed for different conditions of roadways and grades, and renders possible hill climbing, while loaded, without undue exertion.

The most successful road contractors are those who by the purchase of effective equipment reduce the number of men needed. Aside from accomplishing the same construction results in less time and at less cost, considerable worry and delays are eliminated. On account of the scarcity of common labor during the past few years and the high wages paid, laborers on road construction work are generally of the "short-stake" class; they work long enough to get money to go on a carouse. Then, too, the laborer knows that he can quit at any time and get another job just as good as the one he has, with the result that ambition is stifled, men become careless and not care whether they are discharged or not. Consequently, the more efficient the equipment, the less bothersome and expensive the first factor in the road contractor's labor problems; and there is no denying the statement that efficiency per manual unit is very much lower than it was ten years ago, despite the fact that wages per man have materially increased.

Our experience has demonstrated that traction hauling is from 50 to 75 per cent. cheaper than team hauling. The traction outfit will cost little more to install than the team outfit, the cost of maintenance

HUBER *Traction Engine Hauling Broken Stone for Road Construction.*

Traction Hauling Costs

By E. O. Stanley, Stanley Brothers, Contractors, St. Cloud, Minn.

It is not often that a big piece of important road work is completed within the time originally stipulated in the contract for its construction. The main reason for this, in our opinion, does not rest with the rate at which the work proceeds as affected by the contractor's credit and available cash, or by the relative cost of work done in a leisurely way as compared with that done on overtime and in a rush, but by the lack of the most effective equipment to offset the chronic shortage of men.

is less than half; so there is no argument in favor of the team outfit. The tractor is the only kind of traction which is safe with a load on a grade. The great variation in the conditions of roadbeds and percentages of grades and the difference between macadam, clay, gravel and dirt roads make it practically impossible to give an accurate estimate of the cost per ton-mile of traction hauling, as it must, of course, vary on each individual road. The cost, however, can be closely approximated by comparing it with the expense of doing the same work with teams. For instance, on a good, level macadam road, where a team could easily haul a 3 or 4-ton load 20 miles in 10 hours, a Huber

SOUTHERN YELLOW PINE

THE BEST WOOD FOR CREOSOTED PAVING BLOCKS

OWING TO ITS EXTRAORDINARY PHYSICAL CHARACTERISTICS.

Yellow Pine Creosoted Blocks on Whitehall Street, New York City—very heavy traffic.

Mr. H. W. Durham, Chief Engineer in Charge of Highways, Borough of Manhattan, City of New York, states:

> "Our specifications provide that the wood to be used shall be ***Southern Long Leaf Yellow Pine.*** * * * That the popularity of 'Creosoted Wood Blocks' as a paving material is illustrated by its present use—320,000 square yards having been awarded in the City of New York during 1912. * * * Very little trouble and few repairs has resulted when the material has been ***Yellow Pine,*** and the absorption test has been maintained."

The facts are, *Southern Yellow Pine* has made "Creosoted Blocks" a popular paving material, owing to its *great strength under end compression, dense, hard texture, and uniform straight grain.* The resin this wood contains is a preservation in itself, so that Yellow Pine blocks, when properly creosoted, will insure absolute paving satisfaction for *years* in the most trying, congested traffic districts of our largest cities, namely, New York, Boston, Chicago, St. Louis, Atlanta, Cincinnati, Detroit, Louisville, Memphis, etc.

Mr. ENGINEER: Hereafter be explicit. ***Specify "Southern Yellow Pine"*** for your next creosoted paving block contract. It makes an ***economical*** and ***desirable street pavement from every standpoint*** and gives ***longer*** and ***more efficient service*** for the money expended than any other pavement known to engineers.

No royalties paid for its use, and no large repair appropriations necessary.

WRITE FOR LITERATURE AND INFORMATION.

Yellow Pine Manufacturers' Association, 711 Wright Building ST. LOUIS, MO.

traction engine, with special cars would easily haul from 60 to 80 tons from 25 to 30 miles in 10 hours. On a good dirt road, where a team could move from 2 to 3 tons 20 miles in 10 hours, the engine will haul from 40 to 60 tons from 25 to 28 miles in 10 hours. On a road that is soft or sandy, or where grades are steep, where a team could move only 1 or 2 tons over the road, the engine will handle from 20 to 30 tons. The average total cost of operating this engine and cars is about $10 per day, made up of the following items:

Wages of engineer	$3.50
Wages of fireman	1.75
Coal, oil and incidentals	2.50
Interest and depreciation on outfit	2.25
Total	$10.00

The following data on cost of hauling with a Huber 35-h.p. traction engine are based on an average of 1 mile:

Hauled by engine, cubic yards	674
Hauled by teams, cubic yards	2,170
Days outfit was on job	22
Days outfit hauled (fractions are counted as full)	13½

Costs.

Cost for engine operator (salary and expenses, straight time)	$66.00
Cost of fireman (actual days worked)	27.00
Coal, oil and supplies	51.00
Maintenance of outfit	26.00
Total	$170.00
Cost of hauling by traction engine per cu. yd. per mile	$0.258
Actual cost of hauling by teams on same work and same haul, per cu. yd. per mile	.435
Saving per cu. yd. per mile by use of traction engine over teams	.177

Detailed Costs of Engine Hauling Per Cubic Yard Mile.

Operator	$0.098
Fireman	.042
Coal, oil, etc	.077
Maintenance	.041
Total	$0.258

Methods of Street Cleaning in Memphis

The department of street cleaning and sprinkling in Memphis, Tenn., is in charge of Gino Pierotti, who makes use of the methods and apparatus best fitted for the various kinds of pavements. On asphalt, brick, wood block and concrete pavements he uses pneumatic street flushers each of 600 gallons capacity. For the day hand work the Matchless street cleaners are used with automatic pick up and can on a two-wheeled cart. On granite block pavement the regular 2½-inch fire hose is used. The patrol system is also used, each man with a scraper 30 inches wide keeping clean a certain number of blocks a day.

Garbage and rubbish are also collected by this department, which has in use one automobile truck, which makes three to five trips a day thru the congested districts collecting garbage. Most of the collection of garbage and trash is made with dump carts, all the collections being burned in crematories.

The street sprinkling is done with Studebaker sprinkling wagons each of 450 gallons capacity.

All the equipment is owned and operated by the city, and so are the crematories.

Economical Use of Small Mixer

By J. F. Gantz, Contractor, Columbus, O.

A machine mix is much more uniform and reliable than hand mixing, because the thoroness of mixing is not dependent upon the fatigue or carelessness of the workmen.

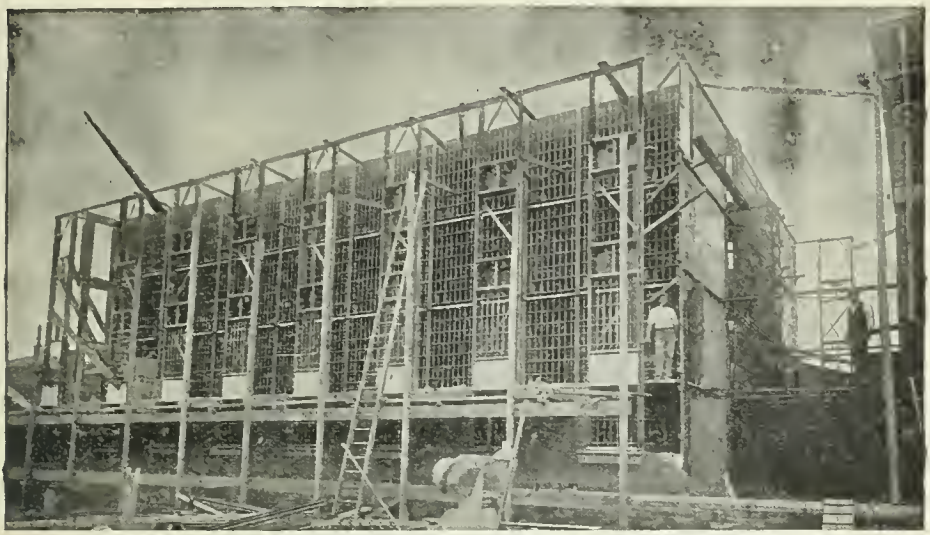
In spite of the above fact, it is quite a common practice to resort to hand mixing on work on which a large mixer cannot be used to profitable advantage.

It is our contention that a small mixer can many times be used advantageously where a large mixer could not have been used. This point was forcibly illustrated in our recent work on a 30-inch concrete sewer in this city.

This sewer runs in the center of Twenty-sixth street for a distance of four blocks as well as in a 14-foot alley for a distance of ten blocks. This necessarily meant that we had to work in a limited amount of space, and altho we had a large concrete mixer, we did not figure on using it for this reason. However, we had our mixer boards on the job when we learned of the "Big-an-Little" mixer which we purchased. This mixer took up less space than our mixer board and we used it to a great advantage when mixing on the street, but when we got into the alley work, there was hardly room enough for the excavation; therefore, from the fact that the mixer was not too heavy and took up very little room, we put it on a platform right over the top of the excavation, and by so doing, made a considerable saving.

The machine was equipped with a one-batch side loader which was easily hoisted to the dumping position. This outfit is compact, thus enabling the workmen on the job to move the mixer in a small fraction of the time required to move a large batch mixer; and in work requiring moving, such as sidewalk and sewer construction, the mixer frequently pays for itself

V=A=N=D=O=R=N



View of Cage containing 120 steel cells at the Hartford County Jail, Hartford, Conn. Erected by us before carrying up outside masonry walls.

WHITE DIAMOND TOOL PROOF

Celebrated Steel Cells

For Prisons, Police Stations and Lockups

We are sole manufacturers ot the Van Dorn White Diamond Material, manufactured by a special process and offered by no other company. By this process our Burglar-proof work is made with an exterior coat of steel uniform in thickness and hardness, absolutely saw, file and drill proof, the core or center part being soft iron. Over 25,000 cells now in use have withstood prisoners of all grades, and the Van Dorn Jail is being known as the safest and most secure jail in existence.

Make Sure You Specify Van Dorn White Diamond Burglar-proof Material

A few of the many jail contracts awarded to us are as follows:

Baltimore, Md. (States Prison) 846 Cells
New York City (Tombs Prison) 352 Cells
Lincoln, Neb. (States Prison) 156 Cells
Moundsville, W. Va. (States Prison) 360 Cells
Boston (Deer Is. Reformatory) 360 Cells
Washington, Wash'ton Co., Pa. 116 Cells
Loog Island City, Queens Co., N.Y. 224 Cells
Pittsburgh, Pa. 200 Cells
Cleveland, Ohio, 250 Cells
Hartford, Hartford Co., Conn. 118 Cells
Buffalo, Erie Co., N. Y. 300 Cells
Rochester, Monroe Co., N.Y. 250 Cells
Harrisburg, Dauphin Co., Pa. 140 Cells
Boston, U. S. N. Prison 150 Cells
Wethersfield, Conn. (States Prison) 187 Cells

THE VAN DORN IRON WORKS CO.
PRISON CONSTRUCTION DEPARTMENT
CLEVELAND, O.

in a few months' time by the greater economy in moving alone. We find it possible to conveniently keep this mixer in very best position for rapid work. One of these mixers and a small gang of men will lay from two to three times as much concrete as the same number of men will accomplish mixing by hand, and the concrete is of far better quality. On the job referred to, a considerable additional saving in labor was effected, as the concrete was discharged into the forms.

There were four men in the mixer crew, one for measuring of cement and operating the loader, one for proportioning of water and dumping the batch and two for wheeling to the side loader. A 1-2-3 mix was used on this work. The average time consumed in batch mixing ranged from 20 to 60 seconds. We had 60 feet of 30-inch sewer forms on the job. When these forms were set we would commence mixing. The average time consumed was two hours to fill the 60 feet, which required about 9 cubic yards of material, showing a net cost of mixing per yard of about 30 cents, or a saving to me of about 90 cents per cubic yard on the mixing of concrete, to say nothing of the time gained, which was considerable and allowed me to complete this job long before I supposed, and take another and complete it this fall.

After our forms were filled we had to wait forty-eight hours before we could pull them and set ready to fill again; so, by having the mixer, we were able to complete the job in less time and with less men than we had figured.

This outfit demonstrated its practicability on this piece of work, and it is our opinion that some kinds of machinery that can be economically used in a larger unit cannot always be as economically used under all conditions, on account of the fact that the depreciation of this machinery during the long part of the year it is not in use more than makes up for the saving effected by its use during a short part of the year. For example, if a contractor has a number of small and medium sized jobs, or large work on which space is too limited for use of large mixer, it would be economical to purchase and use a small concrete mixer. A small mixer will save nearly $1 per cubic yard on concrete placed, and may be purchased for $165 or $250.

The mixing equipment used on this piece of construction was furnished by the Jaeger Machinery Company, Columbus, Ohio.

BIG-AN-LITTLE *Concrete Mixer discharging into sewer forms from edge of trench.*

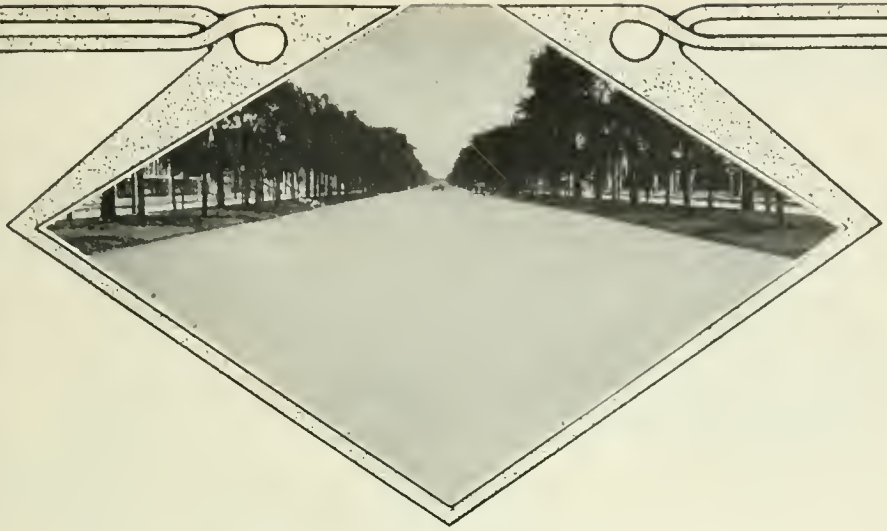
International Motor Company Injunction Dissolved.

The following announcement regarding the International Motor Company is authorized by the officers of the company:

Considerable publicity has been given to proceedings brought by George E. Blakeslee, a stockholder to the extent of 187 shares preferred stock, in which he asks for the appointment of a receiver and an injunction prohibiting the company from borrowing other funds. His application for a receivership and permanent injunction has been dismissed by the court.

Plans have been completed under which the existing or future merchandise creditors of the company will have unusual protection for credit extended. With the exception of bills for merchandise, the company will have practically no obligations to meet for the next three years, beyond its current requirements.

This company is one of the leading manufacturers of motor trucks, having, it is believed, produced and sold more heavy trucks of two-ton capacity and upwards



GRAND BOULEVARD CHICAGO—44-45th STS., CHICAGO,
Paved with Sarcolithic Mineral Rubber, ¾-inch Thick, in May, 1908. No repairs necessary to date.
(Photograph taken July, 1912.)

SARCO PAVING ASPHALTS

make superior street pavements that are extremely durable, positively noiseless, perfectly sanitary and entirely proof against water action. Write for specifications and testimonials.

SARCO

STANDARD ASPHALT AND RUBBER COMPANY
137 S. LA SALLE ST. CHICAGO.

SARCO

SARCOLITHIC MINERAL RUBBER PAVEMENT
City Park Avenue, New Orleans, La.

M·E

than any other concern in the business. The company's annual business has grown until it now reaches approximately $4,000,000.

Much favorable comment among motor truck users in New York City has been made regarding the ability of this company to finance and cause to be erected a most modern and efficient truck service station. This building now stands at West End avenue, occupying the entire block from Sixty-third to Sixty-fourth streets, and represents an investment, with machinery, equipment, etc., of nearly a million dollars.

Motor Driven Police Patrols

"The automobile patrol and ambulance enables the police department to render more efficient service over wider areas," states David A. Matthews, chief of police, Worcester, Mass. "The desperate rivalry existing between our cities in their mad race to excel their neighbors in population, has prompted the extension of the corporate limits from time to time so as to include vast tracts of sparsely settled territory. This, together with the automobile and the trolley car, has introduced a new condition, and develops new difficulties for those who are charged with the duty of furnishing police protection.

"We have in successful operation several White motors in the patrol and ambulance departments, as well as four Marsh-Metz motorcycles. Our experience to date is that motor police apparatus is more efficient, because it is faster, because it is more economical, because it is more sanitary, because immediately after our longest, hardest runs, it is ready to respond to the next call. These facts are stronger than all the eulogistic tributes that might be paid the new type vehicle. They are based on everyday use and experience. They are indisputable and lead to one inevitable conclusion: motor-driven police apparatus is not a luxury, but a vital necessity."

"The reliability of motor patrols and ambulances has been a question of grave concern among police department officials," states Geo. A. Lee, captain, police department, Oak Park, Ill. "Such questions as, will the motor negotiate steep hills, or muddy streets, or deep sand, soft and hard snow, have been the subject of much correspondence between officials whose cities had already bought and those who are contemplating buying motor equipment. By actual tests the motor police patrol has proven to be as free from breakdowns and delays, if properly handled, as the horse-drawn patrol, and should be considered equally as reliable and trustworthy under all circumstances. In negotiating hills the motor patrol will climb grades with comparative ease that it is impossible to ascend with horse-drawn patrols. In muddy streets, thru sand or snow, the motor patrol can get traction; it will plow thru bad stretches that one pair of horses would be sure to fail.

"On September 8, 1912, we placed in service a White motor patrol, whose record to October 10, 1913, is as follows:

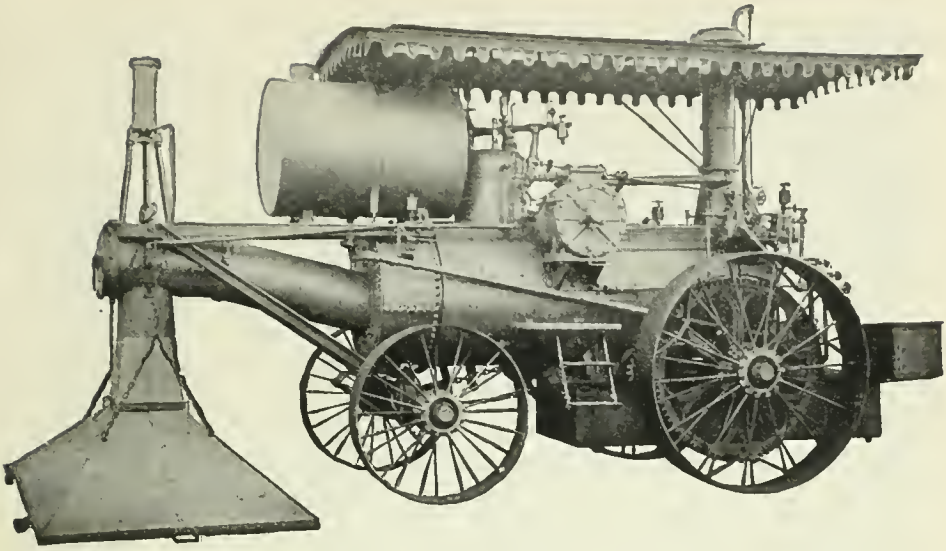
Average mileage per day	10
Total combined mileage	3,650
Approximate number of trips, per year	1,000
Average distance per trip, miles	3½
Average mileage per gallon of gasoline	10
Cost of repairs, including labor and material	Nothing
Cost of lubricating oil	$20.00
Cost of gasoline, 370 gallons	55.50
Total cost	$75.50
Distance traveled, miles	3,650
Cost per mile, cents	about 2 1/5
Cost of operating horse-drawn patrol and traveling same distance for same period	$600
Cost of horse-drawn patrol per mile, cents	about 16½

"We have three White motor patrols in service, with a total mileage of 20,965 to date," states Wm. H. Pierce, superintendent of police, Boston, Mass. "Two more motor patrols of this same make will be placed in service shortly. The first one has been in service since June 5, 1912. The total mileage to date is 12,565 miles. The capacity of the patrol is one ton in weight and will carry twelve officers. Besides using the patrol for arrests, it is also used in transporting prisoners from the Hyde Park police station to the court house in Jamaica Plain, a distance of six miles, and it is used for this purpose every day. It is my opinion that the weight and carrying capacity of this patrol are the proper standards for the purpose for which it is used.

"The main advantage of the motor patrol over the horse-drawn wagon, in my opinion, rests in the low cost of operation and maintenance and the ability to make more and speedier trips over a wider territory. Speed is as desirable a factor in the police as in the fire department.

"In every case, to my knowledge, where the motor patrol has been used, with equal attention given to economical operation as has characterized the same department when on a horse-drawn basis, the change has been to the department's decided advantage from both a financial standpoint and an efficiency standpoint.

"Repairs, tires, gasoline, oil, license fees, etc., cost less than is usually supposed. The motor patrol's chief claims to efficiency are its speed and ability to



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Asphalt Maintenance Costs
By Using The
LUTZ SURFACE HEATER

——gently heats and softens (without flame) old pavements to same consistency as new material. The temperature of both materials being at the vulcanizing point, when tamped, smoothed and rolled a perfect weld is produced, leaving a finished surface. Instead of having a "patch" the repair becomes a part of the whole.

Repairs can be made at a saving of 40 to 50 per cent over the cost of repairing by the old method of chopping up the old pavement and hauling it to the dump. We guarantee every assertion we make. Will you give us an opportunity to show you?

Write us.

Equitable Asphalt Maintenance Co.

Commerce Building. **KANSAS CITY, MO.**

continue indefinitely without tiring. By its speed we are enabled to extend its radius of action over a territory two or three times as great as that covered by the horse-drawn machine, and still obtain efficient police service. We have on several occasions covered a distance of three or four miles with our motor patrols in answer to calls.

"The motorization of police departments will continue to increase in all sections of the country, as it means more efficient police service, even in the sparsely settled sections."

The department of police, Sandusky, O., furnishes the following data based on the operation of an eight-passenger White motor patrol from May 21, 1913, to October 10, 1913:

Average miles per day	12
Total combined mileage	1,725
Approximate number of trips per day	5
Average distance per trip, miles	2 2/5
Average mileage per gallon of gasoline	9 1/3
Cost of repairs	Nothing
Cost of lubricating oil, 23 gal. at 26c	$5.98
Cost of gasoline, 185 gal.: 130 gal at 19c, 25 at 17½c, 30 at 18½c	34.63
Total cost	$40.61
Distance traveled, miles	1,725
Cost per mile, cents	2⅜

Comparative Fire Apparatus Costs

By F. L. Stetson, Chief of Fire Department, City of Seattle, Wash.

From a sanitary and humanitarian standpoint alone, the change from horse-drawn to motor-driven is to be highly commended, but the substitution is highly economical as well.

The work required by fire horses is arduous and often dangerous, accidents not infrequently occur to them, while the keeping of fire horses in the limited accommodations of an engine house has many objectionable features.

There are numerous decided advantages in favor of motor-driven apparatus. For several reasons the cost of maintenance is less. It eliminates the expense of feed and care of horses; it requires fewer men to manage motor equipment, since the hose and ladders may be carried on one truck, requiring but one driver as against three for the equivalent steam equipment. Besides this one driver may work as engineer or in some capacity at the fire. An automobile can travel much more rapidly than can horses and is much more easily managed than they are at the rate at which they travel to a fire.

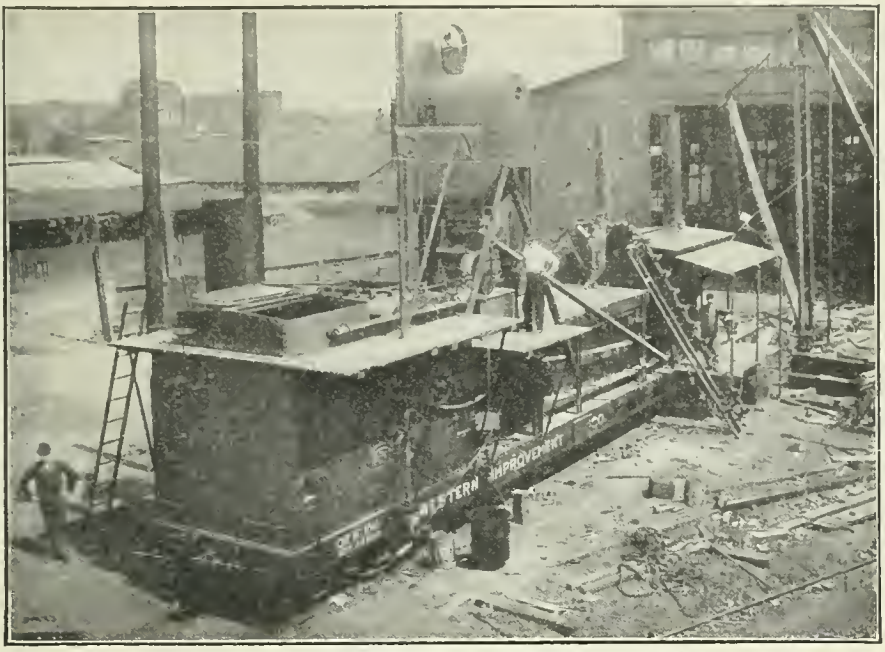
It is ready to leave the engine house without delays necessary to horse-drawn apparatus and when once at a fire the power is instantly ready and the pumps working at full capacity, if that is desired.

For hill climbing, for traveling on bad roads, or in snow, the auto engine had already demonstrated its superiority to horses. In considering all these advantages then, the principal one being that it can reach a fire more quickly than can any other apparatus and thus save time of inestimable value, it is probable that it will ultimately replace horses, at least for city work.

The following comparative costs between our motor driven combination, chemical, aerial apparatus furnished us by the Seagrave Company, Columbus, Ohio, and similar horse drawn equipment clearly indicates that the change is to the best interests of the tax-payer:

Seagrave Combination No. 1. (Hose 25).	
Cost of repairs, including labor and material, 24 months	$212.75
Cost of lubricating oil	20.00
Cost of gasoline, 643 gallons	102.45
Total cost	$335.20
Distance traveled, 1,093 miles, cost per mile	.31
Cost of horse drawn apparatus, 2 horses, with same equipment and traveling same distance for the same period, $1,460.00, cost per mile	$ 1.34
Seagrave Combination No. 2. (Hose 10).	
Cost of repairs, including labor and material, 18 months	$173.60
Cost of lubricating oil	15.00
Cost of gasoline, 276 gallons	41.25
Total cost	$229.85
Distance traveled, 426 miles, cost per mile	.54
Cost of horse-drawn apparatus, 2 horses with same equipment and traveling same distance for the same period, $1,080.00, cost per mile	2.53
Seagrave Chemical No. 1.	
Cost of repairs, including labor and materials, 24 months	$180.00
Cost of lubricating oil	20.00
Cost of gasoline, 550 gallons	82.50
Total cost	$282.50
Distance traveled, 792 miles, cost per mile	.36
Cost of horse drawn apparatus, 2 horses, with same equipment and traveling same distance for the same period, $1,460.00, cost per mile	$ 1.84
Seagrave Tractor for Aerial Truck.	
Cost of repairs, including labor and materials, 12 months	$ 15.00

MODEL OF 1912 ONE-CAR PLANT.



1,000 SQUARE YARDS 2-INCH TOPPING PER DAY.

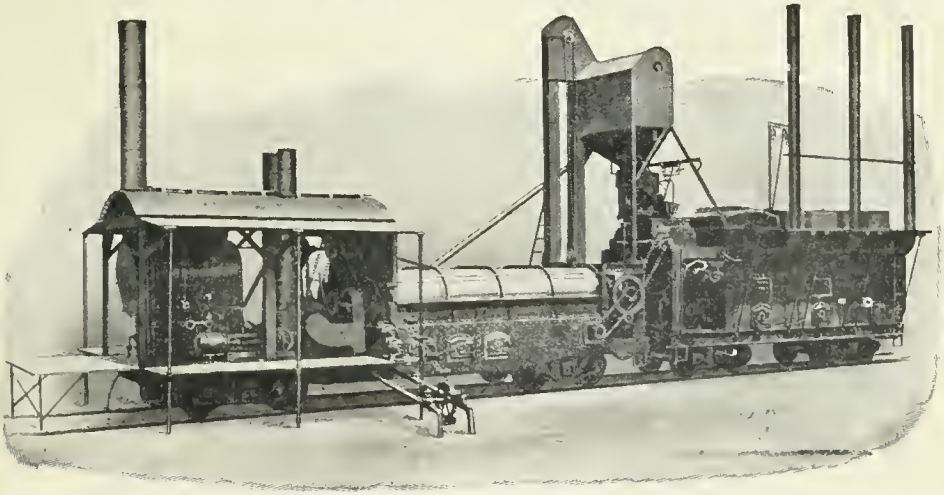
HETHERINGTON RAILWAY ASPHALT PAVING PLANTS

The product of 16 years experience in Plant Building by the originators of the first railway plant. **Still lead, are only safe railway plants made.**

THESE PLANTS HAVE NO EQUALS. WRITE FOR CIRCULARS.

HETHERINGTON & BERNER, - INDIANAPOLIS. IND.

1,500 SQUARE YARDS AND 2,000 SQUARE YARDS PER DAY.



MODEL OF 1912 TWO-CAR PLANT.

Cost of lubricating oil.....	14.90
Cost of gasoline, 149 gallons.....	22.35
Total cost .....$	52.25
Distance traveled, 149 miles, cost per mile	.35
Cost of horse-drawn apparatus, 3 horses with same equipment and traveling same distance for same period, $1,095.00, cost per mile	7.34

Elm Roots Clogged Sewers

By J. M. Johnson, City Engineer, Marion, S. C.

Seven years ago, Marion had constructed a system of sewers whose construction was, in many respects, inferior to what it should have been. At any rate, many of the streets in which these sewers were laid were lined with red and white elm trees, than which there is nothing that can root or clog a sewer more quickly or more effectually.

The sewers had been becoming obstructed for several years. Branches at times have been completely clogged by roots. We undertook to open these sewers with the ordinary sewer rod (non-floating) in connection with various attachments. Except in rare instances we finally dug to the sewer, after making signal failures with rods, etc., broke into the sewer and opened and repaired, etc. With the excessive amount of solid matter in the rooted sewer, we could never get more than 200 feet of rods into the sewer. As we had, at that time up to 1,200 feet of sewer between man-holes, 600 feet being about minimum, we had quite a troublesome matter on our hands. As unsatisfactory as this method was, it cost us about 25 cents per foot to get obstruction removed without cleaning the sewer. Thru the kind offices of MUNICIPAL ENGINEERING, we got in touch with the Turbine Sewer Machine Renovating Co., of Milwaukee. After corresponding with them, we signed a contract for a demonstration of their machine in this city. When machine and demonstrator arrived, we volunteered all assistance needed but put the machine on the worst sewer we had. In a short time the demonstrator had his floating rods thru, then the cable, then the machine, and the sewer was as clean, and smoother than when laid. This operation was repeated time and again. We purchased the machine and have continued to use it ever since. We operate it as easily as the demonstrator and just as cheaply, in fact I believe more so. The cost of cleaning sewers has been reduced from 25 cents to about 1¼ cents per foot.

The machine was equipped to work 450 feet maximum. It was such a simple matter to work it up to this distance that when we purchased same, we also purchased 150 feet additional rods, cable, etc., so that we could work 600 feet and at this distance, it is just as easy an operation, taking into account the additional weight of hose, etc.

We expect to clean our sewers periodically. We have not as yet ascertained how often this operation will be required. Our opinion is that it will be necessary once in 2 years. The operation, of course, would vary in different systems and even in different branches in the same system. I believe that if health officers were required to look into the sewers occasionally, sewers in every city would be more frequently cleaned.

Semi-Portable Bituminous Mixing Plant

With the increasing use of bituminous macadam and the demand for closer economy and exact methods in asphalt road and street construction, the need has been emphasized for a relatively small, compact mixing plant of moderate first cost and minimum expense for maintenance. Such a plant must be suitable for various mixtures and sufficiently portable to overcome the loss entailed in excessively long hauls of the finished mixtures.

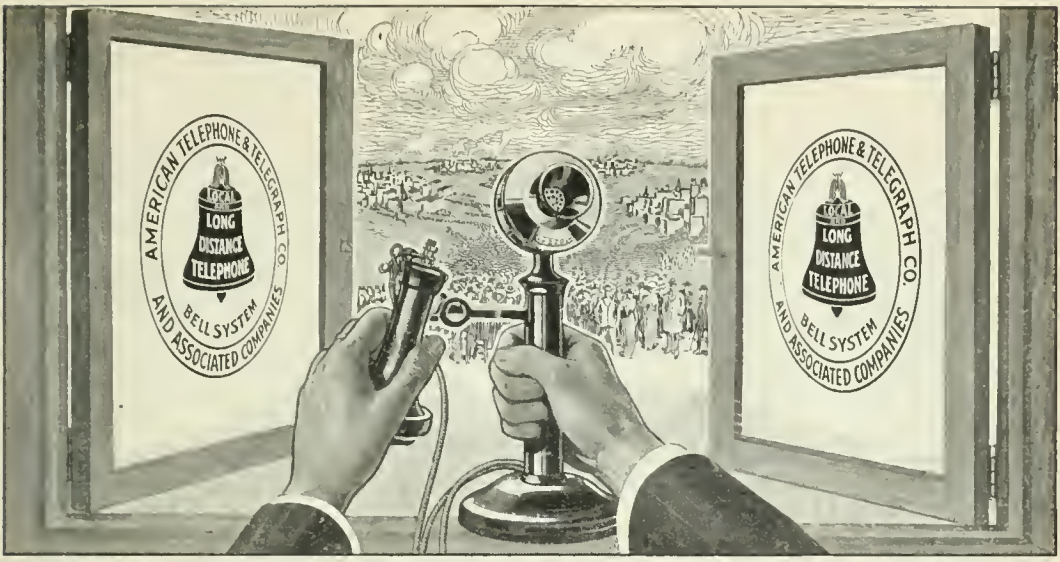
To meet these conditions the plant here described has been designed and built at the Iroquois Works of The Barber Asphalt Paving Company.

The plant consists of four units, portable boiler and engine, portable single-drum driver, portable melting tank and mixing tower, which are so arranged that the plant in its entirety can readily be moved and re-assembled.

The portable boiler and engine, selected for the particular duty to be performed, has power largely in excess of the actual requirements of the plant, thus insuring certainty of operation and permitting flexibility in case it is found desirable to increase the normal capacity of the plant. The boiler is of 60-h.p. locomotive type with a 55-h.p. horizontal engine placed over the boiler-shell. The entire unit is mounted on four substantial wheels.

The melting kettle has a capacity of 1,556 gallons and is a self-contained unit with a refractory-lined fire unit, fire and ashpit doors, and arranged for steam or air agitation as the purchaser may prefer. This unit is mounted on three 6-inch heavy section I beams for portability.

The single-drum drier is of the "Iroquois" standard type, containing every refinement suggested by a quarter century's experience in the asphalt paving



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Wherever you may be, a multitude is within reach of your voice. As easily as you talk across the room, you can send your thoughts and words, through the open doors of Bell Service, into near-by and far-off states and communities.

At any hour of the day or night, you can talk instantly, directly with whom you choose, one mile, or a hundred, or two thousand miles away.

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It is the duty of the Bell System to make its service universal, giving to everyone the same privilege of talking anywhere at any time.

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industry. The drum proper is 40 inches in diameter and 20 feet long, complete with firebrick and asbestos-lined steel setting, firing chamber, double rain roof, elevators, etc. It is a complete self-contained unit mounted on substantial steel axles and wheels.

The mixing tower is constructed of four main columns consisting of heavy section steel I-beams carrying the necessary platforms, all securely braced with tie rods and turnbuckles. To facilitate dismantling and re-erecting the several members are bolted together. The mixing tower unit is fully equipped with a standard 9-cubic-foot Iroquois steam-jacketed mixer, with two sets of shafts and teeth, enabling the purchaser to produce any one of the several mixtures likely to be called for—binder, bituminous macadam, asphaltic concrete or standard sheet asphalt surface mixture. A two-compartment sand bin of total capacity of 218 cubic feet is supported between the upper legs of the tower. A rotary screen and cradle is mounted directly over the sand bin, and is equipped with jacket for the proper separation of the mineral aggregate; the screen can readily be jacketed to meet any modification in the mineral aggregate. The tower carries a dust collector of improved design and is so located that the dust collected is delivered above the line of the top of the mixer, making it available for use as filler. The necessary accessories, such as weighing box and scale for mineral aggregate, traveler, bucket and scale for the bituminous material, power fan, link-belt elevators, etc., are parts of this unit.

Capacity. Those familiar with the production of bituminous surface mixture fully appreciate that the capacity of a mixing plant is limited by (a) the maximum capacity of the mixer employed, and (b) the capacity of the drier. In the plant here described the drier has a capacity for handling a scientifically graded cold sand of the composition required for a standard sheet asphalt surface mixture, containing not more than 5 per cent. of moisture, at air temperature 77 degrees F., and delivering same to the conveyors at 350 degrees F., at the rate of 6 tons (12,000 pounds) per hour of continuous operation. The mixer, however, has a capacity of more than double the capacity of the drier, making it possible to double the capacity of the plant by installing an additional drier unit and kettle unit. A superficial square yard of standard sheet asphalt surface mixture, 2 inches in thickness, may safely be assumed to weigh 200 pounds. The drum capacity is based on 160 pounds of sand (alone) included in a square yard of surface mixture consisting of sand, filler and asphalt cement. Six tons (12,000) pounds) of sand is the equivalent of 75 square yards per hour or 750 square yards of 2-inch surface per day of 10 hours. On coarser aggregates intended for bituminous macadam or asphalt concrete, the drum capacity will materially increase.

The plant as designed contemplates the use of steam for agitating the molten bituminous material. If desired, a complete air installation can be substituted. The first of these plants to be built has been purchased by the city of Springfield, Mass.

Trade Publications

The Association of American Portland Cement Manufacturers, Land Title building, Philadelphia, Pa., has published a pamphlet giving "Facts Every One Should Know about Concrete Roads."

An advance circular has been received from the Austin-Western Road Machinery Company, Chicago, Ill., announcing the new Austin tandem motor road roller for rolling asphalt, brick and tarred pavements, which is said to have many improvements over previous steam machines. A full description of the operation of the roller will be given later.

"Bitulithic Pavements for Residential Streets, Suburban Districts and Boulevards in Chicago," is the title of an illustrated article by Geo. C. Warren regarding the success of bitulithic pavements in Chicago and the condition of litigation over patents in Illinois, which is issued by Warren Brothers Company, Boston, Mass.

Bulletin 63A of the Jeffrey Manufacturing Company, Columbus, O., gives the latest price lists of Jeffrey detachable link chain attachments and wheels.

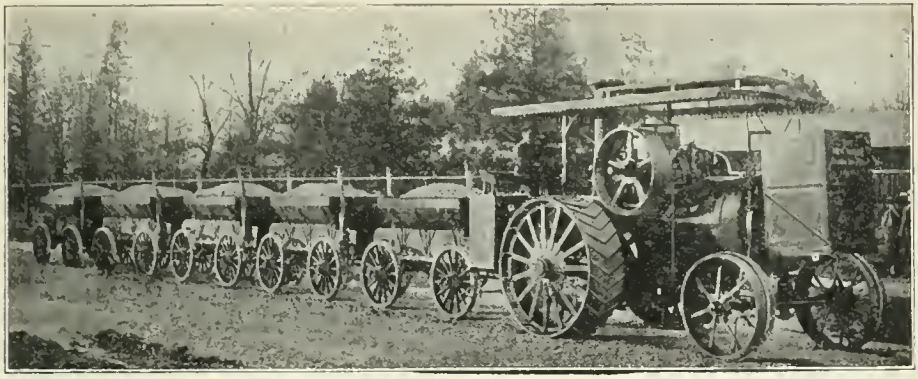
The Morrison Boiler Company, Sharon, Pa., issue a fully illustrated circular regarding their water-tube boilers and methods of setting them.

The Blackmer & Post Pipe Company, in a handsome booklet, entitled "Deliverance from Plague," demonstrate the advantages of sanitary sewers and the merits of vitrified pipe for their construction, giving specifications for pipe and suggestions about trenching and laying pipe and protecting the ends for railroad culverts, sewers, drains, gravity water pipe lines, etc., as well as methods and results of testing pipes. Special drain, conduit and gutter pipes are also considered, as well as vitrified block lining for large concrete or brick sewers.

"The Whole Kewanee Family" of pipe specialties is described in a booklet of that name, published by the National Tube Company, Pittsburgh, Pa.

"Six Centuries with Coldwell" is the

Huber Steam Tractor Hauling Stone



30 Miles Per Day for 5 Months hauling 75,000 pounds of crushed rock at one-half the expense of moving it with horses.

TURNHAM & TALBERT
CONTRACTORS

MINNEAPOLIS, MINN.:—

"The Huber Engine which we purchased last year has proven a very *good investment.* We used it about five months on a five-mile haul, making three trips each day, covering a total distance of thirty miles. We hauled twenty-four yards of crushed rock to a load (about 75,000 pounds), and were able to move it at one-half the expense of moving it with horses. In fact, we could not have completed our contract within the time limit had we depended on teams. The *expense for fuel was very small,* and we had *practically no lost time on account of breakages.*

"You certainly have a durably built engine, and it is, in our opinion, *the most practical power for heaving hauling.*"

Haul Your Stone and Roll it Down with a

HUBER COMBINATION TRACTION ENGINE and ROAD ROLLER

—change easily made

Jack up the front end of boiler, remove two bolts, detach steering chains, and remove front truck. Then the roller attachment is placed in position and bolted, steering chains connected, cleats taken off the drive-wheels by removing the bolts which hold them. Now you have the finest kind of steam road roller.

Better send for your copies of contractor engine and road building books.

HUBER COMBINATION ROAD BUILDERS ARE BIG MONEY SAVERS

The Huber Manufacturing Co.

601 Center Street. **MARION OHIO.**

Representatives for Eastern Canada, F. H. HOPKINS & CO., Montreal.

title of a handsome booklet commemorating the faithful service of twenty-one employes of the Coldwell Lawn Mower Company, Newburg, N. Y., for periods of twenty to forty-four years, aggregating over six hundred years in all.

"Some Concrete Facts" compares a plain concrete section of a pavement with a Dolarway section, to the advantage of the latter. It is issued by the Dolarway Paving Company, Whitehall building, New York City.

MacGowen & Co., New York, issue a monthly catalog of electrical and steam machinery, cars, etc., which they have for sale.

The Leavitt-Jackson Engineering Company, Brooklyn, N. Y., issue a circular regarding their automatic chlorinator for the sterilization of water and sewage.

The fall number of "The Mixer," issued by the Koehring Machine Company, Milwaukee, Wis., has a striking cover and interesting contents.

"The Labor Saver," No. 61, Section 1 of S-A general catalog No. 19 of the Stephens-Adamson Mfg. Co., Aurora, Ill., and is devoted mainly to power transmission machinery for stone crushers, coal handling, etc., and goes into minute details.

United steel sash is the subject of a new 112-page catalog just issued by the Trussed Concrete Steel Co., of Detroit, Mich.

Bulletin NA of Bausch and Lomb Optical Co., Rochester, N. Y., is an abbreviated catalog and price list of their surveying instruments.

The McWane Meter box is a new candidate for favor, made by the Lynchburg Foundry Co., Lynchburg, Va.

The Standard Scale and Supply Co., Pittsburg, Pa., has issued its Contractor's Equipment catalog which illustrates and fully describes the "Standard" concrete mixer and line of equipment.

Frank Whiteley, Waco, Tex., is promoting what he calls mozaik roadway, a combination of macadam and concrete, laid in a special manner and coated with an asphalt surface finish and has issued circulars describing the same.

The Exposition Fact-Book is issued by the Panama-Pacific International Exposition, San Francisco, Cal., and gives advance information regarding the holding of the 1915 conventions of organizations in connection with the exposition, concerning the exposition itself, the expenses of attending it, the sights of California and methods of reaching them. Copies will be sent on request.

Nesco News is the house organ of the National Enameling and Stamping Co., Granite City, Ill.

Bulletin 132 of the De LaVergne Machine Co., New York City, describes, illustrates and details their type FH oil engine.

Trus-Con armor plate and Trus-Con curb bar for protecting joints in concrete pavements and edges of curbs and other concrete constructions respectively, are shown in two recent publications of the Trussed Concrete Steel Co., Detroit, Mich.

A description of the new garbage and waste disposal plant of the "mixed method" at Paris (Ivry), France, has been issued by E. B. Stuart, 36 South Ashland Boulevard, Chicago, Ill. Special application of the description is made to the present Chicago conditions, and estimates of cost of construction and operation of plants for Chicago are given. He also issues a circular regarding the "cold tower" system of treating night soil which is also applicable to a certain extent in sewage and garbage disposal.

The Ohio Quarries Co., Cleveland, O., are distributing literature concerning their Buckeye Berea sandstone curbing, calling attention particularly to the fact that practically all the streets inspected by the engineers present at the recent Cleveland meeting of the National Paving Brick Manufacturers Association were curbed with their material and to the fact that the curb placed on Carnegie Ave., in Cleveland, forty years ago, has been retained on the street with the new pavement which is the third laid on that street, thus demonstrating its permanence.

The Bulletin published monthly by the General Contractors' Association, 51 Chambers St., New York City, has published a supplement which contains an extended itemized summary of all the bids for New York subway construction received by the Public Service Commission of the First District, New York, from October 27, 1910, to August 19, 1913, which is for sale at 50 cents. It should be of great value to contractors and engineers, especially in the east, for all the prices for all the items in all the bids received are given in detail.

Trade Notes

The General Contractors' Association, 51 Chambers street, New York City, has issued a subway supplement containing all the bids on New York subway contracts from October 27, 1910, to August 19, 1913, which will be sent for $1.

The H. W. Johns-Manville Co. have taken larger quarters in Baltimore, at 207-13 East Saratoga street, in the center of the business section. The building has six floors, each 47 by 187 feet, and, in addition to warehouse accommodations and a railroad switch into the building, will have an attractive store and up-to-date offices.